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NEURINOMA OF THE FACIAL NERVE

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NEURINOMA is the designation of a peculiar tumor arising from the cells of the sheath of Schwann, specifically the primitive stages of the latter, and therefore the tumors are ectodermal in origin. They are composed partly of Schwann cells and partly of connective tissue, whereas they do not contain true neural tissue. A more detailed histologic description is given in works by Verocay [1] and Korbsch [2] and, more particularly, by Antoni,[2a] who, in a larger monograph, accounts for their origin and structure. A number of the peripheral tumors often contain an admixture of collagen connective tissue, which is often present in large quantities, for which reason the term fibroneurinoma, coined by Verocay, ought to be adopted as the proper designation of these tumor, instead of neurofibroma (von Recklinghausen), as theses tumors do not contain true neural tissue.

The tumors, being partly solitary and partly multiple (as in von Recklinghausen's disease, also called multiple neurofibromatosis), attack the cranial nerves as well as the peripheral ones. Of the former, only the olfactory and optic nerves seem to escape. As the posterior roots are attacked with a rather remarkable frequency, the usual site of formation of tumors as regards the cranial nerves is chiefly the unmixed sensory nerves, especially the acoustic nerve, but tumors may grow also from the mixed nerves and when present here they will commonly be found on the sensory root.

As the development of a neurinoma on a cranial nerve containing only motor fibers is of extremely rare occurrence, the relative frequent occurrence on the facial nerve is a striking feature. But is the facial nerve an unmixed motor cranial nerve? Is the view adopted at present according to which the facial neurinomas are accepted as sure examples of neurinomas originating from an unmixed motor cranial nerve correct? It should be borne in mind that several investigators have maintained that the facial nerve contains some sensory fibers (Mygind,[3] for instance,

1. Verocay, J.: Beitr. z. path. Anat. u. z. allg. Path. **48**:1, 1910.

2. Korbsch, H., cited by Altmann.[5]

2a. Antoni, N. R. E.: Ueber Rückenmarkstumoren und Neurofibrome, Munich, J. F. Bergmann, 1920.

3. Mygind, S. H.: Personal communication to the author.

having three times succeeded in producing a sensation of pain by directly touching the denuded facial nerve) and that from these neurinomas may have arisen. According to this view the facial neurinomas should possibly be regarded as examples of neurinomas originating from the sensory roots of mixed cranial nerves.

To the case recorded in Denmark by Schroeder [4] I may add the following one.

REPORT OF A CASE

A woman of 32 years was admitted to Frederiksborg County Hospital on April 25, 1944. She had had no previous diseases of the ear. In the winter of 1935 acute coryza, with purulent discharge, attended by neuralgic pain was present on both sides of her face. On Oct. 22, 1935 the medical outpatient department of Rigshospitalet had demonstrated "some tenderness at the site of emersion of the trigeminal nerves." Roentgenograms of the paranasal sinuses showed nothing abnormal, nor did the rest of the objective examination show anything in particular. She was treated with pills containing 3 grains (0.19 Gm.) of quinine twice daily. The patient stated that shortly afterward a good deal of pus was discharged from the nose, after which the pain subsided.

In 1936 the patient one day had a severe boring and throbbing pain behind the right ear, the pain arising spontaneously, without any preceding symptoms. About twelve hours later peripheral paralysis of the right side of the face suddenly developed, which soon became complete, and at the same time there was a reduction of the sense of taste along the right margin of the tongue. There was no pain in the ear itself, no discharge, no ringing in the ears and no nausea or vomiting, just as there were no herpetic vesicles and no fever. The patient was treated with injections of posterior pituitary and with massage and electricity. For two months the paralysis was complete; then it began to disappear, and during the following seven years there was a slowly progressive improvement of her state, although the paralysis did not altogether disappear. Since 1942 she had been treated with the Clemmensen myotensor. During all these years the patient had a permanent throbbing and boring pain behind her right ear, varying in intensity but never completely gone, so that, for instance, not even on the hottest summer day could she be out-of-doors without wearing a thick motor helmet pulled well down over her right ear.

Two months before her admission to the hospital there was an exacerbation of the paralysis, which occurred suddenly, so that in the course of two days the paralysis was complete once more, but this time too there was no pain or ringing in the ear and no giddiness, nausea or vomiting.

On admission on April 25, 1944, a practically complete paralysis of the right side was found; the patient was not able to wrinkle her forehead or close her right eye, and only slight twitches could be produced at the corner of the mouth. There was no impairment of the taste in the anterior two-thirds of the tongue, no tenderness along the facial nerve and no enlargement of the lymph nodes at the tip of the mastoid process or at the angle of the mandible.

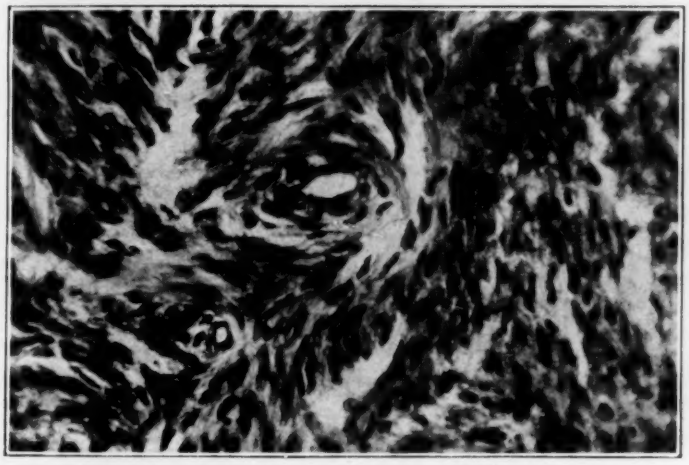
In the right ear the tympanic membrane was somewhat dull, with hyperemia of the vessels of the posterior malleolar fold; the external acoustic meatus was normal, there being especially no sign of tumor masses in the upper part of the

4. Schroeder, R.: Hospitalstid. **72**:773, 1929; Acta psychiat. et neurol. **4**: 163, 1929; Dansk otol. selsk. forh. **31**:56, 1930.

posterior wall. The right mastoid region was normal. The left ear was normal. A whisper could be heard at a distance of more than 6 meters on both sides. On complete neurologic examination nothing abnormal was found. The Wassermann reaction was negative. The sedimentation rate in one hour was 5 mm. The hemoglobin content was 98 per cent. Roentgenograms of the temporal bones showed nothing abnormal.

On the basis of the symptoms, a diagnosis of relapsing Bell's palsy was made. Decompression of the facial nerve on the right side by the method of Ballance and Duel was performed on April 26, 1944.

The superficial cellulae were dry and glossy; the antrum, too, looked normal. During the procedure of looking up the stylomastoid foramen, a cavity larger than a hazelnut was suddenly exposed to view, containing grayish-reddish masses of granulations and a single, white, epidermis-like, spherical object about the size of a pea. Above, the destruction extended as far as the lateral semicircular canal, while posteriorly it just fell short of the sinus; below, it reached the stylomastoid foramen, and on the anterior aspect it opened into the facial canal.



Photomicrograph of a neurinoma of the facial nerve.

The continuity of the nerve, lying denuded on the floor of the cavity, had been broken as regards the superficial fibers, whereas the deeper fibers were left uninjured. The membranous covering of the posterior wall of the osseous acoustic meatus was intact. The tumor was removed and the walls of the cavity smoothed, after which the superficial fibers of the nerve were carefully placed in contact with each other; finally, the nerve was covered with gold leaf. Primary suture was done.

Regarding the postoperative course, there is nothing special to be said. Eighteen months after the operation the paralysis was still complete, but during all these months the patient had been entirely free from pain. As no traces of returning mobility could be discovered, the patient was reoperated on. No connection could now be found between the proximal and distal parts of the facial nerve, and consequently a nerve graft was inserted.

The microscopic appearance of the supposed granulation tissue (prosector: S. Petri, M.D.) presented the following characteristics: "The five pieces of tissue

sent in for examination all present the same appearance and consist for the most part in a dense, cellular tumor tissue composed of numerous, elongated, uniform elements, separated by a faintly staining, delicate, filamentous and reticular stroma, here and there the seat of a slight edema. There is no distinct difference in the size of the nuclei, and there are no sure mitoses. In several places the tumor cells have a pronounced tendency to be arranged in a special fashion, bringing about a pattern of moiré. Scattered through the tissue highly vascular areas are seen, consisting in a network of wide, thin-walled vessels filled with blood, with the result that the tissue in these places derives a slightly hemangiomatous appearance. At varying interspaces the tumor tissue contains a few partly intact, partly disintegrating medium-sized spicules of bone, of which only granular debris is left. There is no granulation tissue and no inflammatory infiltration or necrosis. There are no cholesterol crystals or desquamated epithelium, no nerve endings and no structures characteristic of fibroma, neurofibroma or neuroma.

Apparently there can hardly be any doubt that the pathologic processes are due to a benign tumor derived from the nerve sheath, the cells of which present the features common to growths like that. The pathologic-anatomic diagnosis was neurinoma, or schwannoma.

Comment.—In a woman aged 32 years, seven years ago, after she had for twelve hours without interruption suffered from a boring and throbbing pain behind but not in her right ear, complete facial paralysis suddenly developed on the right side, accompanied with gustatory disturbances. After it had remained complete for two months the paralysis gradually subsided under conservative treatment, without, however, disappearing altogether, and during these years the pain behind the ear had constantly been present. Two months before her admission to the hospital a sudden exacerbation occurred in the course of two days, so that the paralysis became complete once more, this time without any subsequent improvement. The condition was diagnosed as relapsing Bell's palsy and was accordingly treated with a decompression of the facial nerve according to the method of Ballance and Duel, during which a tumor the size of a hazelnut, arising from the descendant part of the facial nerve, was discovered.

The total number of records of cases in the literature of neurinomas arising from the facial nerve amounts to 16, in 13 of which the diagnosis was made clinically (Altmann [5] [5 cases], Schmid,[6] Schroeder,[4] Bogdasarian,[7] Lundgren,[8] Roberts,[9] Skoog,[10] Ohnisi [11] and Williams and

5. Altmann, F.: Monatschr. f. Ohrenh. **69**:1032, 1935; **71**:1287, 1937.

6. Schmid, C., cited by Altmann.[5]

7. Bogdasarian, R. M.: Neurinoma of the Facial Nerve, Arch. Otolaryng. **40**:291 (Oct.) 1944.

8. Lundgren, N.: Nord. med. **28**:2384, 1945.

9. Roberts, G. J.: Neurinoma of the Facial Nerve in the Middle Ear and Mastoid: Report of a Case, Arch. Otolaryng. **37**:62 (Jan.), 1943.

10. Skoog, T.: Acta oto-laryng., to be published.

11. Ohnisi: Zentralbl. f. Hals-, Nasen- u. Ohrenh. **28**:669, 1937.

Pastore[12]), and in 2 of which the conditions were observed casually at autopsy and dissection respectively (Kos,[13] and Greifenstein); the last (Wysotskaja[14]), finally, has been published in a Russian periodical which was unavailable to me.

Altmann has in two works compiled from his own 5 cases in Neumann's department, supplemented with the materials of Schroeder, Schmid and Greifenstein, attempted to establish the clinical aspect of the facial neurinomas the details of which he had combined so as to constitute the following picture: 1. The tumor generally develops in youngish people. 2. The first and, frequently, for a long time the only symptom is the facial paralysis, which may develop gradually or occur suddenly, being as a rule permanent, as only in 1 case a temporary improvement was observed. 3. The acoustic meatus is partly or completely occupied by the tumor masses, and it is doubtful whether the facial palsy occurs before the tumor can be seen in the meatus. 4. The tympanic membrane and the hearing remain intact for some time. The tumor grows expansively, and, resulting from the ingrowth into the middle ear and the subsequent secondary infection of the latter, there are symptoms of chronic otitis media; in case of further advance, labyrinthine and (as in Schroeder's case) intracranial complications may ensue. 5. Severe pain is totally absent.

The site of formation is usually the descendant portion of the facial nerve, as in this case too, which, respecting the pathologic-anatomic features, bears a striking resemblance to that of Schmid. But the tumor may also arise from the horizontal portion; thus Greifenstein, when doing an autopsy on a 32 year old man who had died from a tumor of the pituitary gland, observed a neurinoma, which, after having passed through a dehiscence in the facial canal above the foramen ovale, had grown down into the latter and filled it out, pushing the mucous membrane of the middle ear before it like a pouch. In Bogdasarian's case the tumor also arose from the horizontal portion of the nerve. Finally, it has not been possible to establish the precise site of origin in a series of cases on account of the size and expansion of the tumor.

In the 13 cases reported in the literature, in which the patients obtained medical treatment, the tumors were visible in the meatus, appearing (1) as swellings of the posterior wall of the acoustic meatus, feeling soft to the touch of a probe (Schmid,[6] and Ohnisi[11]); (2) as polypi, bearing a disconcerting resemblance to the polypi seen in chronic otitis, or (3) as obturating tumors in the acoustic

12. Williams, H. L., and Pastore, P. N.: Neurofibroma of Facial Nerve in Facial Canal: Destruction of Labyrinth and Mastoid Process, Arch. Otolaryng. **29**:977 (June) 1939.

13. Kos, C. M.: Ann. Otol., Rhin. & Laryng. **49**:151, 1940.

14. Wysotskaja, L. D.: Zentralbl. f. Hals-, Nasen- u. Ohrenh. **34**:326, 1941.

meatus (Altmann [5] and Lundgren [8]), and (4) in 1 case the tumor was so large, growing in clusters like a bunch of grapes, that it occupied all available space in the cavum conchae (Williams and Pastore [12]). In Schroeder's case the acoustic meatus had narrowed into a mere slit, from which abundant quantities of foul-smelling pus were pouring out, and the whole of the mastoid process was the seat of a tender, red swelling, of an inflammatory appearance (large subperiosteal abscess). Finally, (5) in Bogdasarian's case the drum membrane was bulging, and after a myringotomy the tumor prolapsed into the acoustic meatus.

The lesion found at operation has ranged from a minor, well defined focus around the pars descendens (Schmid [6] and Kettel [15]) to extensive destructions of the mastoid process, inclusive of the posterior and even the anterior wall of the acoustic meatus, the middle ear, the labyrinth and the pyramid (Altmann,[5] and Williams and Pastore [12]), and in 1 particular case the tumor had penetrated the internal ear and had set up an abscess of the brain (Schroeder [4]).

In the case reported, the following clinical characteristics are consistent with the picture set up by Altmann; in my case, too, the patient was a youngish person, and during many years the facial paralysis had been the only symptom of the disease, but Altmann, having observed a temporary improvement in only 1 of the 6 cases constituting the material for his pathologic picture, considered the paralysis to be stationary, whereas in my case the paralysis was subsiding in the course of seven years, although not disappearing altogether, and then it suddenly became complete once more.

Further, Altmann considered it questionable whether facial paralysis occurs before the tumor becomes visible in the acoustic meatus. In my case, although the paralysis was of many years' standing, there was nothing abnormal about the acoustic meatus, and consequently I was unable to make the diagnosis of neurinoma and able to make only that of relapsing Bell's palsy, a condition presenting, in my opinion, a good indication for the performing of decompression.

In one additional respect, and a decisive one, my case is different from the others: During all these years the patient had continuously had a severe throbbing and boring pain behind her ear, and only after the removal of the tumor was she completely relieved of this pain.

To set up, in the manner of Altmann, a clinical picture of a tumor, the localization of which is so precarious, on the basis of so few cases as the number referred to can, in my opinion, hardly be done, and therefore I want only to emphasize that my case differs from the majority of the rest in the fact that the facial paralysis was not stationary but gradually improving during seven years, then suddenly to become

15. Kettel, K.: Nord. med. **24**:1783, 1944.

complete again; that the paralysis had persisted during all this time without the appearance of the slightest sign of a tumor in the acoustic meatus, and that the patient was suffering continuous and severe pain for years.

Altmann is dealing with the differential diagnosis toward other otogenic diseases, in the first place, chronic otitis media and, in the second place, tuberculosis and carcinoma of the middle ear. In the latter diseases there is a discharge from the ear for a long time before the development of facial paralysis, which with the neurogenic tumors is often for years the only symptom to be seen. Altmann stated that destructions of any larger extension, demonstrated by means of roentgenograms in the neighborhood of the posterior and inferior walls of the bony acoustic meatus, the floor of the tympanum and the lateral wall of the atticus, may speak in favor of the diagnosis of a tumor as opposed to that of simple chronic otitis media; the same holds true of a high development of the pneumatic system. The absence of other tuberculous changes makes the diagnosis of tuberculosis less probable, and in carcinoma, which practically always develops on the basis of chronic otitis media, the paralysis occurs late and not early. According to Altmann pains tell against the existence of a neurogenic tumor (a statement I have not been able to confirm, as already mentioned), whereas it is a common symptom in carcinoma. Conclusive of the diagnosis in any case is microscopic examination of tissue excised for biopsy.

The differential diagnosis between a neurinoma which has received medical attendance at a time when the tumor has not yet become visible in the acoustic meatus and the diseases of nonotogenic origin causing facial paralysis, especially Bell's palsy, involves great difficulty. Even by going over the record of the case afterward it was hardly possible to make the diagnosis. The only partial disappearance of the paralysis is no unfamiliar occurrence in Bell's palsy (this being the case in about 20 per cent), and the relapsing character of the paralysis is by no means a sign of the presence of a tumor, facts I have learned from experiences acquired through a series of decompressions performed in cases of relapsing Bell's palsy. Neither did the roentgenogram, despite the tumor's showing normal conditions, render any support. The only circumstance that might perhaps have aroused my suspicion is the continuous pain, which does not come within the picture of simple Bell's palsy and which might perhaps have pointed in the direction of another cause of the paralysis, thus suggesting that the allegation set forth by several investigators to the effect that the facial nerve contains sensory fibers is correct. That in the beginning Bell's palsy is accompanied with pain is a well known phenomenon.

On the whole the prognosis is favorable quoad vitam, although some reservation would be appropriate, as the site of the tumor near the middle ear and the labyrinth implies the risk of complications from the latter when the tumor grows into them.[16] The prognosis as regards the future function of the nerve, on the other hand, is bad.

The therapy is exclusively surgical. On the time at which the patient applies for treatment depends not only the question of whether the tumor may be removed radically but also the possibility of whether the middle ear may be spared. Irradiation has been attempted but without any effect (Altmann).

If the removal of the tumor is carried out with success, it will, since the continuity of the nerve will most often be broken over some distance, become necessary to perform nerve grafting according to the method of Ballance and Duel, an operation which in this department too has proved to have an extremely favorable prognosis.

CONCLUSION

In a woman of 32 years a neurinoma of rather more than the size of a hazelnut was removed from the pars descendens of the facial nerve. The clinical picture differed in various essential respects from that outlined by Altmann on the basis of earlier published cases.

1. The paralysis need not remain complete but may disappear, to recur later on.

2. The paralysis may persist for years without the tumors being visible in the acoustic meatus.

3. Severe pain may be present almost constantly for years.

It is called in question whether it is correct to regard the facial neurinomas as examples of neurinomas originating from an unmixed motor cranial nerve. Several authors have maintained that the nerve also contains sensory fibers; the tumor might possibly have arisen from these.

If this is true it might account for the comparatively frequent localization to the facial nerve, as the neurinomas practically always arise from sensory nerves or from the sensory roots of mixed nerves. The pain suffered by the patient, lasting for years and not disappearing until after the operation, is suggestive of the correctness of this explanation.

Frederiksborg County Hospital.

16. Schroeder's patient is still alive, sixteen years after the operation. He is, however, unable to work, and on account of fits of fainting and fury he has four times been referred to a hospital for mental diseases. The palsy is still complete, the fistula is closed and apparently the tumor has not grown.

STENOSIS OF THE NASOPHARYNX AND ITS CORRECTION

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AND
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NASOPHARYNGEAL stenosis is a relatively rare condition. It consists in scarring and contracture of the mucous membrane and submucosal tissues of the nasopharynx following destructive damage to them. This process may involve the posterior pharyngeal wall anywhere from the adenoids down. It then may include the lateral walls and extend forward to the pillars of the fauces. Some cases include the free margins of the palate as well. There are all degrees of involvement, from moderate distortion of the normal anatomy, not giving rise to symptoms, to inclusion of all the structures, resulting in a contracture ring that distorts the entire nasopharynx and occludes it with a thick diaphragm of scar tissue, which gives rise to nasal obstruction and a change in voice.

The etiologic factors behind this picture of destruction and scarring of the tissues are trauma and infections. Traumatic injury may follow burns, but burns due to lye and other ingested caustics invariably involve the hypopharynx and esophagus instead of the nasopharynx, so that in our series we have not seen such a case. Operation is a common cause of loss of tissues in this area and in most cases has followed operation on the tonsils and adenoids. The amount of scarring and subsequent contraction in these cases depend on the amount of mucous membrane and muscular tissue that has been destroyed. When there has not been infection as a complicating factor, the resulting stenosis is due to a contracting ring of scar tissue along the margin of the soft palate and pharynx, which pulls the palate posteriorly to adhere to the nasopharyngeal wall. The resulting diaphragm in such a case is comparatively soft and flexible, and when it is cut from the posterior pharynx the elasticity pulls it well away from the pharyngeal wall. It is in such a case that the best results may be anticipated, because the tissues are flexible and viable, and we do not expect sloughing of our flaps.

When infection has been added to an operative loss of membrane, there may be associated with it some sloughing of the muscles and

From the Plastic Clinic of the Massachusetts Eye and Ear Infirmary.

membrane, which is conducive to a dense scarring and fibrosis. When this occurs the resulting stenosis is tough and thick, and it is difficult to create a flap of such tissues which will live.

Of the infections, we have encountered syphilis, tuberculosis, diphtheria and rhinoscleroma. Syphilis probably causes the thickest avascular scarring, and the result is the most difficult type of atresia to treat.

Of the 2 syphilitic patients treated by us, examination revealed dense, thick, scarring, with little if any evidence of muscular motion. The scarring not only included the palate and nasopharynx but extended down into the hypopharynx.

With this picture in mind, it is rather easy to visualize how difficult it would be to create viable flaps or to apply skin grafts to them which would live. In regard to the skin grafts, not only is the bed on which they are placed not conducive to life but the field is septic and constantly in moderate motion despite a large stent or other form of immobilization. Because of these facts, we are inclined to view some of the cases of syphilis that is difficult to treat as did MacKenty.[1] In his report he advocated extensive excision of the dense scarred tissue, even though this may infringe on the function of the remaining palate to the extent that it would accentuate a nasal voice or even permit fluids to enter the nose. Should this condition occur, it may be partially if not completely corrected by the insertion of a properly fitted dental obturator.

In the evaluation of cases of syphilis as a whole, it is our contention that if a patient has sufficient opening to care for the nasal secretions it is best to leave the patient alone. The nasal airway for the function of breathing is of secondary importance.

The case of tuberculosis that we had was somewhat similar to the cases of syphilis in that there was pronounced scarring that was extensive and thick. The condition differed from them in that the scarring did not appear to be so firm.

Most otolaryngologists see postoperative cases of tonsillectomy in which the tongue has been drawn somewhat into the tonsillar fossae. This situation is more of an atresia of the oropharynx than of the nasopharynx and rarely requires correction. It rarely gives rise to symptoms, though occasionally a patient is seen that has definite difficulty in swallowing due to a pronounced contracture of this type.[2]

The literature on nasopharyngeal stenosis is scanty. Figi,[3] presented 18 cases of the condition. In 4 of these the stenosis occurred

1. MacKentry, J. E.: Nasopharyngeal Artesia, Arch. Otolaryng. **6**:1 (July) 1927; Three New Plastic Operations on the Nose and Throat, M. Rec. **53**:1071, 1911.

2. Kazanjian, V. H.: Stenosis of the Oropharynx, J. Oral Surg. **3**:164, 1945.

3. Figi, F. A.: Stenosis of Nasopharynx, Arch. Otolaryng. **10**: 480 (Nov.) 1929.

after tonsillectomy and adenoidectomy and in 2 after tonsillectomy alone. In 3 it was due to congenital syphilis, while in 2 it was the result of the disease acquired. In 2 cases it followed inflammatory reactions, in 2 it was due to rhinoscleroma, in 1 to diphtheria and in 1 to a burn and in 1 it was claimed to be due to congenital obstruction.

Of our series of 16 cases of operation, in 9 of them the nasopharyngeal stenosis was a result of operations on the tonsils and adenoids. In 3 of this number the stenosis was complicated by sepsis, with subsequent necrosis of the tissues. In 2 of the remaining cases it was due to syphilis, in 1 it followed tuberculosis, in 1 it was due to injury and in 1 it was due to scarlet fever complicated by ulceration. The history in this last case was consistent with that of diphtheria. The age group of the patients in our series, as in those of other authors, places the condition as occurring in the first three decades. In 11 of them the condition occurred below the age of 30. Syphilis occurred in the older age brackets. In an analysis of the literature, it is evident that congenital atresia of the nasopharynx is rare, that in the majority of the cases the condition follows an operative procedure and that some of these cases of operation have been complicated by sepsis with subsequent ulceration.

The atresia following tonsillectomy and adenoidectomy is not always due to poor surgical treatment but to inadvised surgical treatment or operation complicated by infection. If it is due to operation, the operator has been too enthusiastic in the removal of all lymphoid tissue that is present in the nasopharynx and base of the tongue and sufficient membrane has not been left on the posterior pillars or between the islands from which the lymphoid tissue was removed, so that during healing a continuous traction ring is formed, which results in the stenosis. If due to operation and sepsis, the infection has destroyed the mucous membrane together with much of the underlying muscle, permitting the stenosis to follow.

REVIEW OF LITERATURE

In 1896 Nichols [4] discussed the scarring sequelae of syphilis in the pharynx plus its treatment. He advocated the inserting of a suture through the base of the web, tying it tightly and leaving it in place. This would gradually cut through the cicatricial tissue, and the tract would become epithelized. This procedure was repeated by the insertion of other sutures laterally until an adequate tract and airway resulted.

4. Nichols, J. E. H.: Sequelae of Syphilis in the Pharynx and Their Treatment, Tr. Am. Laryng. A. **18**:161, 1896.

Five years later, in 1901, Curtis [5] presented an excellent paper on the repair of a stenotic nasopharynx due to congenital syphilis in a young woman. His comment concerning this condition is unchanged today and will be the same years from now, as time will not change the underlying anatomic and physiologic condition creating the stenosis. He stated, "It is well known how difficult to treat and how liable to recur are the well-marked cases of cicatricial contraction of the pharynx, especially those which are the result of syphilitic ulceration."

He presented a surgical procedure which consisted in the swinging of a flap of skin from the neck in through a lateral pharyngotomy opening to line an area on the left and on the posterior surface of the pharynx created by the cutting out of the stenotic tissue. At a later stage, the pedicle was cut and replaced and the neck opening closed. This created an opening after healing was complete that permitted the passage of a ¾ inch (2 cm.) bougie. The symptoms of the patient were relieved.

More recently, Cinelli [6] reviewed the literature and then advocated insertion of a large, soft, rubber tube into the nasopharynx following the excision of the contracting scar, the tubing being left in place until the epithelization about it was complete.

Goodyear [7] reported 2 cases. In the first one, the stenosis was nearly complete and the diaphragm was comparatively thin, so that he was able to make a horizontal cut through the diaphragm near to its attachment to the posterior wall. When this flap contracted, the cut surfaces were not in apposition and they healed over without closing the original stenosis. In the other case a similar incision was made, but in this instance it was necessary to keep the incised tissue separate and this was done by the passing of a rubber catheter from the pharynx up through both sides of the nose, where it was tied in front of the columella. Sufficient catheter was permitted to remain in the pharynx so that a loop extended through and below the incision, thus keeping it open. The patient was instructed to pull this loop of catheter up into the nasopharynx and replace it several times a day. This procedure kept the area open until epithelization had occurred from the cut edges.

MacKenty [1] offered constructive papers, in which he advocated the use of flaps in the correction of this condition. These flaps were created from adjacent tissue and so manipulated as to cover most of the raw

5. Curtis, B. F.: Cicatricial Stricture of Pharynx Cured by Plastic Operation, Ann. Surg. **33**:152, 1901.

6. Cinelli, A. A.: Nasal Atresias: A Surgical Critique, Ann. Otol., Rhin. & Laryng. **49**:912, 1940.

7. Goodyear, H. M.: Nasopharyngeal Atresia: Description of Operation, Arch. Otolaryng. **29**:974 (June) 1939; **32**:512 (Sept.) 1940.

surface that was left by incisions made to relieve the stenosis. In this manner little raw surface was exposed which would permit further stenosis. This principle is sound from a surgical point of view, and it has proved to be the principle of choice in our series.

MacKenzie [8] treated a patient with rather extensive stenosis by inserting a vitallium mold into the area that was created by the cutting of the fibrotic bands. This mold was constructed from an impression made with dental compound at the time of the original operation. This vitallium mold was left in place from four to six weeks, until epithelization was complete.

McIndoe [9] discussed the problem and advocated application of a skin graft held in place over a dental stent.

To correct this condition, Figi [3] advocated the utilization of pocket skin grafting. This is employed to reestablish some of the lost epithelium, which in turn may be utilized to cover the raw surface established by opening up the stenosis.

SURGICAL TREATMENT

Before operation is attempted, it is always essential to determine the exact extent of the fibrosis and scarring, so that the operation may be preplanned. It is imperative that we consider the etiologic factor behind the scarring. Should it be due to operation or superficial ulceration we may assume that the submucosal muscles are fairly free from fibrosis, but should it be due to destructive invasive infection or infiltrative processes, such as extensive necrosis, associating bacterial invasion or necrosis following syphilis, we shall find that the submucosal tissues are densely scarred and poorly supplied with blood. The thickness of the obstruction may be determined by palpation with a probe through the nose and a finger in the mouth, by the use of the nasopharyngoscope and by roentgenographic examination following the instillation of iodized poppyseed oil. Appreciating the thickness of the scar tissue and the extent of normal mucous membrane and keeping in mind the cause of this condition, one is guided in deciding on the operation of choice.

In the majority of our cases, examination revealed a scarred, irregular diaphragm extending from the posterior and lateral pharyngeal walls, upward and forward, and involving the margin of the soft palate and the tonsillar fossae. This mass of scar tissue created a diaphragm which closed off the nasopharynx from the oropharynx and pulled the palate and pharyngeal tissues together. In most of the

8. MacKenzie, C. M.: Intubation Following an Operation for Cicatricial Stenosis of Nasopharynx, Arch. Otolaryng. **34**:1035 (Nov.) 1941.

9. McIndoe, A. H.: Application of Cavity Grafting, Surgery **1**:535, 1937.

cases there was a small perforation through this tissue so that secretion from the nose could drain into the throat, though the opening was not adequate for breathing purposes, and in some cases a pool of mucous secretions remained in the nose. In other cases the tongue was drawn up into the tonsillar fossae, creating a partial stenosis of the oropharynx.

In our hands, the utilization of a plug following the removal of scar tissue or the application of a skin graft to a denuded area in the nasopharynx has not been satisfactory. It is our impression that the failure in such cases was due to the fact that it was impossible to hold a skin graft immobilized in the nasopharynx, because of the continuous motion created by swallowing plus the poor vascular field on which the graft was placed, together with the ever present pronounced degree of sepsis that is in this area. The patients on whom this was tried were helped but not to the degree that had been desired. The utilization of a plug was also partially successful, though the stenosis recurred to a large extent following its removal.

It seems advisable to omit detailed histories of cases; instead we shall present the physical findings in selected illustrative cases together with the surgical procedures that were employed to correct them. Each case presents its own problems, but the fundamental principles that we endeavor to utilize are the same in all cases and were gradually developed while this series of patients was being treated. An attempt is made to create flaps of the neighboring tissues that are covered with mucous membrane and to manipulate them in such a way as to cover any and all denuded surfaces that are created by the excision or correction of the stenotic area. The following case is a typical example of such a procedure.

REPORT OF CASES

CASE 1.—This is a case of complete stenosis of one side and partial stenosis of the opposite side occurring in a 5 year old boy. It followed a secondary tonsillectomy and adenoidectomy that were done for a great deal of hypertrophied lymphoid tissue of the pharynx. Following healing, examination revealed a pronounced narrowing of the nasopharynx, with a band of scar tissue which extended from the posterior pharyngeal wall to the left tonsillar fossa, with a small passage up into the nose which would correspond to the area between the apex of the tonsillar fossa and the uvula (see fig. 1). On the opposite side, there was a complete stenosis of the nasopharynx up to the uvula. The opening was sufficiently small to cause difficulty in nasal breathing.

The operation in this case consisted in the creation of two flaps on the side of the complete stenosis. The first incision was made along the cicatricial band that formed the midline margin of the completely stenosed side (see figure 1 *A*). It was carried above the level of the uvula and down onto the normal pharynx. A parallel incision was made laterally to this, corresponding to the midline of the tonsillar fossa. A third incison was made at the base of these two, and

this incision formed the free margin of the first flap. The flap was dissected free up to the top of the original incisions, care being taken not to go through to the nasopharynx. When the flap was dissected out to its base a cut was made through to the nasopharynx (fig. 1 *B* and *D*), and then the lateral incision was carried down to the base of the stenosis, where it attached to the nasopharynx. This created a second flap. The first flap was folded on itself, thus covering its under surface (fig. 1 *C* and *E*). The second flap was brought forward and down and sutured on itself, thus covering the second raw surface (see figure 1 *C* and *E*, flap 2). There then remained only the raw surface that corresponded to the

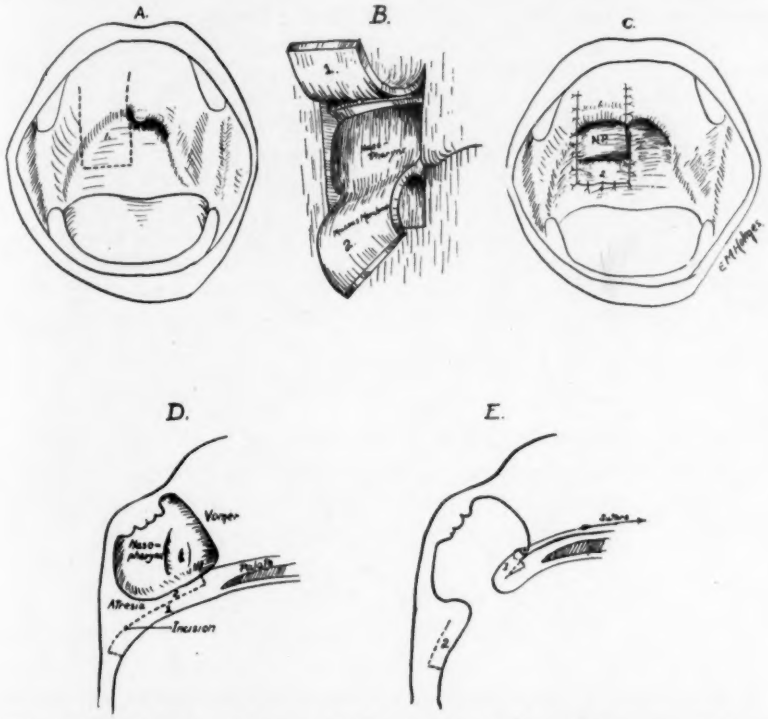

Fig. 1 (case 1).—*A*, the extent of the stenosis of the nasopharynx, which was complete on the right and nearly so on the left. The dotted line indicates the primary incision for the creation of flap 1. This was carried halfway through the stenosed tissue. *B*, the original flap lifted up. At its base the incision was carried through to the nasopharynx, as shown in *B* and *D*, and then flap 2 was created. *D*, a cross section of the stenosis, with the creation of two flaps. *E*, the two flaps sutured in place. *C*, the finished correction of the stenosis, with the flaps sutured in place, covering all raw areas.

lateral incision, which was closed by suturing. No further treatment was carried out, and a sufficient airway was created to give complete relief of the symptoms of the patient.

In this case we were dealing with a boy whose stenosis followed operative trauma. There had been little or no loss of muscle tissue, the stenosis having followed contraction and adhesion of the exposed

raw surfaces. The blood supply and vascularity of the parts were good, and in such a case one may anticipate that flaps can be created that will not contract excessively and that will be viable.

CASE 2.—The patient in this case presented a complete stenosis of the nasopharynx except for a 2 to 3 mm. hole in its center (fig. 2*A*). The cause, as in the preceding case, was trauma, so that the scarring, though diffuse, was not deep and the vascularity of the area was good except in the central scar itself. The diaphragm of cicatricial tissue extended along the margin of the soft palate across the lateral and posterior pharyngeal walls, sloping downward from the palate. It was a fairly even thick sheet of tissue.

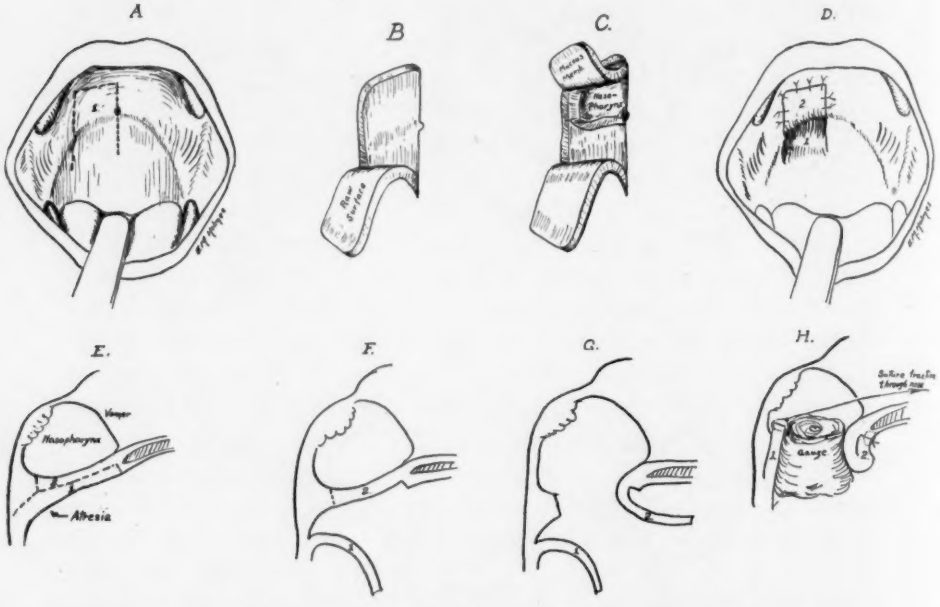

Fig. 2.—*A*, the complete stenosis of the nasopharynx except for the small perforation. The dotted line indicates the initial incision through the mucosa. *B*, diagrammatic illustration of flap 1 dissected free, leaving one half of the thickness of the tissues to form flap 2, which the dotted line indicates. *C*, the second flap created and the opening made into the nasopharynx. *D*, flaps 1 and 2 sutured in their final position, covering all raw surfaces and creating a nasopharyngeal opening. *E*, diagrammatic section to show the atresia and the dissecting incisions employed to create the flaps. *F*, flap 1 dissected free. *G*, flap 2 completed. *H*, the method in which flap 1 was made to come in contact with the raw surface of the posterior part of the pharyngeal wall.

The operation in this case was similar to that in case 1 in that hinged flaps were employed. It was different in that the flaps were reversed. In case 1 the front flap was hinged onto the palatal surface, whereas in this case the flap was hinged from the pharynx.

The operation in this case was performed in two stages, one side being treated at a time. Two flaps were formed, scarred and normal tissue being utilized. An incision was made from the perforation in the midline upward for about

1 inch (2.5 cm.) and was then carried laterally for another inch (fig. 2*A*). The cut was made through the mucous membrane, care being taken not to extend it more than halfway through the diaphragm. The incision was then carried down along the lateral pharyngeal wall, including the scar tissue which was in the tonsillar fossa. A flap of tissue was then dissected, care being taken to preserve the palate and nasal surfaces (fig. 2*B*, *E* and *F*). When this was dissected down to the point where the stenotic diaphragm met the posterior pharyngeal wall, an incision was made through to the nasopharynx (fig. 2*C*, *E* and *F*). This buccal flap no. 1 was created to cover the denuded area of the posterior pharyngeal wall, but in its creation it left a raw surface on the soft palate. To cover this, another flap was created from the remainder of the stenotic diaphragm, the epithelial nasal surface being utilized (see figure 2*C*, *E*, *F* and *G*). When this was freed and thoroughly undermined, it was readily folded to cover the raw surface of the palate, as illustrated in figure 2*D* and *H*. This same procedure was then carried out on the other side, and when the flaps were sutured in place an adequate opening had been created into the nasopharynx and all raw surfaces had been covered with living mucosa.

It was impossible to suture the palatal flap over the raw posterior pharyngeal area. The same goal was accomplished by the attaching of sutures to the end of the flap, passing them through the nose and applying gentle traction (fig. 2*H*). This held the flap over the raw area but not against the surface. To accomplish this, a pack was gently inserted in the nasopharyngeal opening until the flap had become adherent.

After complete healing and contracture, there was adequate airway and drainage to give the patient complete relief.

Theoretically, these two procedures appeared feasible and sound. It was not until they were attempted that the operator fully realized that he could not expect the outlined flaps to retain their original size or to cover the area anticipated in all cases. On cutting through the stenosed area, one is first impressed by the tightness of the diaphragm. The extent of the contracture is then forcibly realized when the tissues return toward their original position, leaving extensive denuded areas which cannot be covered by the planned flaps. This situation is more acute in stenosis which has resulted from extensive destructive lesions such as those due to syphilis and tuberculosis. In an endeavor to overcome this problem and to cover the resulting raw surface, it was decided that a broad liberal flap of mucous membrane could be taken from the adjacent cheek. It was found that such a flap would successfully cover the denuded surface and that the area left by the flap could be closed by direct approximation. This procedure is illustrated in the next case, and it is our opinion that it or a similar method is the procedure of choice in most cases of nasopharyngeal stenosis.

CASE 3.—M. C., a patient aged 61, had stenosis of the nasopharynx following scarlet fever which was associated with ulceration. Since that time she had been hoarse. Examination revealed complete stenosis of the nasopharynx with a small perforation through it. The scar tissue extended down the posterior pharyngeal wall and into the larynx, involving the anterior half of the vocal

cords, which had fused. The scarring of the nasopharynx was tough and irregular, so that it would require two different forms of flaps to overcome the stenosis. One procedure was carried out on the right side; another was planned on the left. The first incision started in the midline, as shown in figure 3 *A*, and included the fistula, extending from the base of the stenosis on the pharynx forward to the hard palate. It was then carried laterally toward the alveolus and down again along the side of the tonsillar fossa. This flap was dissected free from its bed, care being taken not to go through to the nasopharynx. A second incision was made through the cicatrix in its attachment to the posterior pharyngeal wall (fig. 3 *D* and *E*). Another incision was made through into the nasopharynx, and the lateral aspect of this cut followed the original incisions. This created flap no. 2, that was raw on the front surface but lined on the nasopharyngeal surface. It was swung forward, folded on itself and sutured to the raw area created by the removal of the first flap (see figure 3 *B* and *F*). The original flap was pushed through the nasopharyngeal opening to cover the raw surface that had been exposed there (see figure 3 *B* and *F*). There still remained a raw area on the palate (see figure 3 *B*). To cover this, a fairly long flap was taken from the buccal mucosa, which was readily pulled over and sewed in place. This corrected the stenosis on this one side. The stenosis on the other side was of a different nature and was primarily due to one large contracting scar, which extended from the midline laterally to the tonsillar fossa. It was so dense and extensive that it seemed advisable to permit the first operation to heal and to evaluate the success there before further corrective procedures were attempted. It was found that the first operation gave sufficient relief from her symptoms, so that a further operation was not necessary. The patient could breathe freely through the nose, she had no further retention of the nasal secretions and her voice became more resonant.

It had been planned to employ a Z incision on the left side, the long central cut being along the scarred raphe and the two diagonal cuts to be so constructed that the flaps could be transposed, thus removing the contracting band and at the same time freeing the palate.

Some of the patients in earlier cases in this series were operated on by the utilization of the procedures described by other operators. Skin grafting, pocket skin grafting, the insertion of a stent following the removal of scar tissue and other procedures were used, but the end results were not gratifying. Some of the patients operated on by these methods were helped moderately, while others failed completely.

It was forcibly demonstrated that the stenosis following syphilis, tuberculosis or other ulcerative destructive diseases was the most difficult to handle. This is self evident when one considers that the stenosis is caused by and consists of an avascular fibrous scar tissue. When such tissue is excised and an attempt at creating a flap is made, the flaps constrict greatly and because of their avascularity are apt to slough. One may expect most success in patients in whom the stenosis has followed surgical trauma, in which the loss has consisted of the superficial epithelium and possibly some of the muscles but in which there has not been secondary infection, with resulting slough of the tissues.

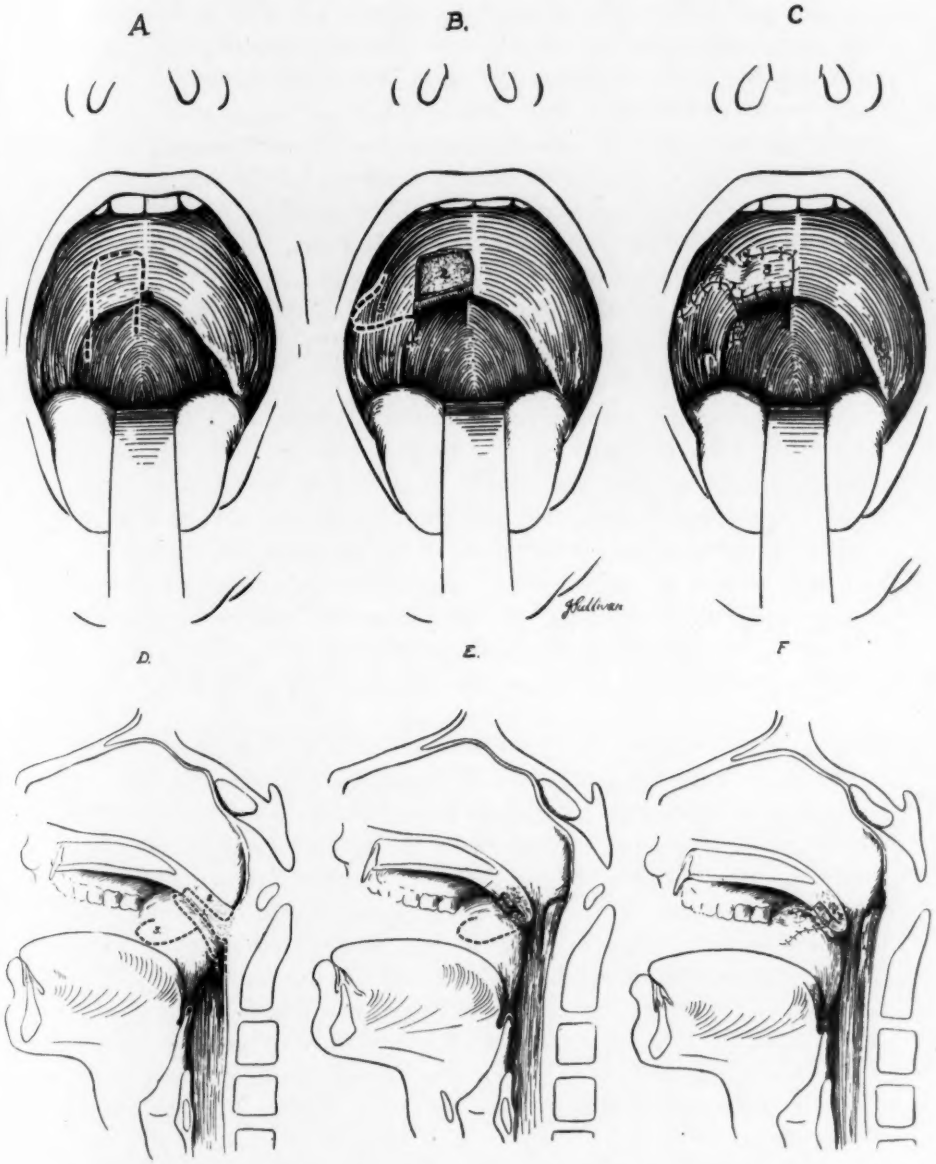

Fig. 3.—*A*, stenosis similar to that in figure 1 except that the stenosis on the patient's right was comparatively soft, whereas that on the patient's left consisted of a tight thick band. The incision is indicated by the continuous line. *B*, the two flaps that were created as in case 1, sutured in place, leaving a raw surface which is to be covered by flap 3, taken from the buccal mucosa. *C*, flap 3 sutured in place, thus covering all the denuded area. *D*, cross section diagrammatically illustrating the incisions which created the three flaps surfaced with mucous membrane. *E*, diagrammatic illustration of the creation of the two flaps, both lined on one surface with mucous membrane. *F*, the relative position of the three flaps when held in place.

The goal in this type of pathologic change is to relieve the presenting symptoms, which are usually nasal obstruction associated with a retention of the nasal secretion, which in turn causes a nasal voice. Not infrequently sinusitis is a coexisting condition.

It was found that success could be counted on more frequently when flaps which employed as much normal membrane and tissue as possible were created. Flaps were created with this in mind and so manipulated that they could cover any and all raw surface that was created by the excision of the contracted scar tissue or diaphragm.

One expects contracture following such an operation, and in all cases there was some degree of retraction and narrowing of the area created associated with healing.

In judging the appearance of the throat following the operation, we must first be guided by the changed anatomy that was present prior to operation and then realize that the goal sought was function and not anatomic beauty and symmetry, as most of the patients presented scarring and distortion both before and after operation.

The criteria of success in these cases should be judged by the relief of the troublesome symptoms that the patient had prior to the operation. If one is able to relieve the nasal obstruction and establish drainage for the retained nasal secretions, the operation may be called successful.

CONCLUSION

Stenosis of the nasopharynx is fortunately a comparatively rare condition, as it is one which is difficult to overcome. A brief review of the literature is presented together with the various types of operations that have been advocated by different operators. Of our series of 16 cases of operation, in 9 of them stenosis was caused by operations on the tonsils and adenoids. In 3 of these the operation on the tonsils and adenoids was followed by infection of the tissues, which sloughed, creating an extensive exposed area which granulated and resulted in a contracture. In 2 other cases in the series the nasopharyngeal stenosis was due to syphilis; in 1 each it was caused by tuberculosis, injury, scarlet fever and rhinoscleroma, and in 1 it was of undetermined infection.

The stenosis which follows some destructive infectious process such as syphilis or tuberculosis is the most difficult type of stenosis to correct. This is due to the diffuse, avascular, dense scarring which does not tolerate operation, epecially the creation of flaps, and on which grafting or flaps will not readily adhere.

The patients whose stenosis follows surgical trauma may anticipate a more promising end result.

In this series of cases, skin grafting, pocket skin grafting, excision and then insertion of an obturator were tried. It became evident to us that these methods were prone to disappointment except in cases which presented soft vascular tissues about and near to the stenosis. We experienced more satisfactory results when planned flaps were utilized. Some of these flaps may be made of the scar tissue that is covered with mucous membrane, but it became evident that in the cases with the most successful results a flap taken from the adjacent cheek was employed also.

Once the stenosis is overcome one must expect narrowing of the opening on healing, but if the opening remains patent enough to permit the passage of adequate air and secretions so that the patient is symptom free one may consider the operation as successful.

CONCUSSION DEAFNESS

CAPTAIN JAMES V. STEWART
AND
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MEDICAL CORPS, ARMY OF THE UNITED STATES

A UNIQUE opportunity to study the effect of gun firing on hearing has been offered by the prolonged exposure of instructors while teaching gunnery students. For the purpose of this study 100 white male gunnery instructors averaging 25 years of age, assigned to both shotgun and 50 caliber machine gun ranges, were studied with the aid of an audiometer and by whispered and spoken voice. Each of them was found to have normal hearing on examination prior to assignment to the range. There was no history of previous otologic difficulty or injurious medication, such as quinine. Each had been examined with an otoscope both before assignment to the range and during the course of this study. There was no evidence of present or past otitis externa or media. All had intact tympanic membranes; however, there were occasional calcareous plaques or scars from old healed perforations. When the latter was present the subject could not usually recall the time this had occurred. Not a single one gave a history of tinnitus of even the most transitory nature prior to assignment to the range.

The minimum length of service was six weeks, the maximum thirty months and the average ten months. On the ranges, firing is almost continuous for seven and one-half hours per day five and one-half days a week. Absorbent cotton had been used universally as an ear plug and during the period covered by this survey was the only protective device employed.

The noise level on ranges where forty or more .50 caliber machine guns are firing is high and subjectively produces acute distress when first encountered. Men involuntarily duck, clasp their hands over their ears and have an almost uncontrollable impulse to run away when they first go on the range. It is almost as if they were struck a physical blow by a mass of sound. This first sensation of physical onslaught passes in a few minutes, and one soon becomes adjusted to the noise. On cessation of firing after a single exposure of a few hours, there is a "numb" feeling in the ears. One can almost hear the stillness, but auditory acuity is not diminished (chart 1). Tinnitus, however, is sometimes present after a single exposure but is invariably of short duration. We have failed to see tinnitus persist even twenty-four hours following a single exposure.

After repeated exposure, on the other hand, tinnitus may become a persistent and annoying symptom. Of this group of 100 previously normal white men, persistent and unrelenting tinnitus was noted in 30 and intermittent tinnitus, severe enough to demand medical attention and cessation of duty on the range, was present in an additional 20. Even in the patients with persistent tinnitus, it was aggravated by exposure to firing and was maximal at the end of the day. On reassign-

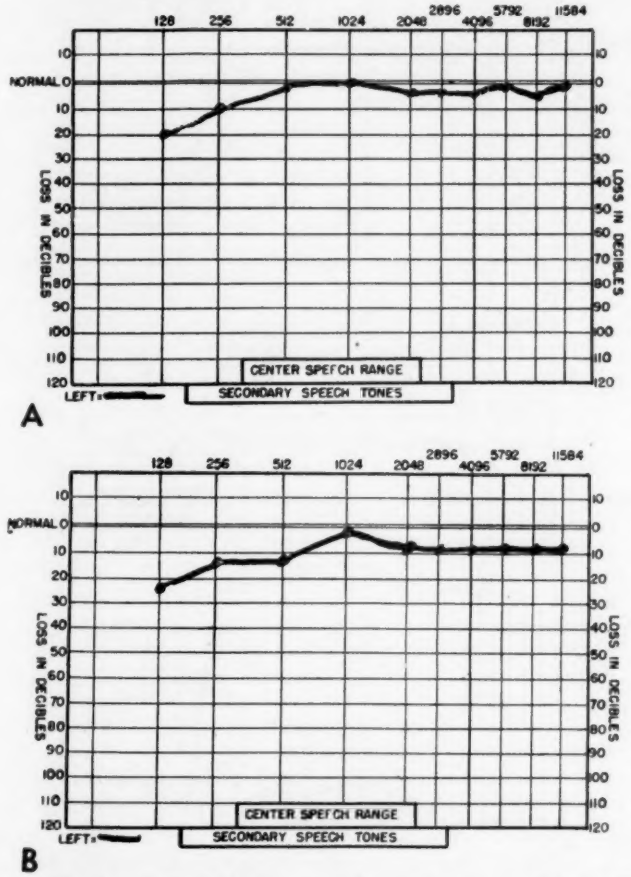

Chart 1.—Hearing in the left ear: *A*, prior to exposure; *B*, immediately after seven hours' exposure on the .50 caliber machine gun range.

ment tinnitus tends to diminish, but in some of the men considered in this article it has persisted throughout the period of follow-up (six months). The minimal service on the range in the group with severe tinnitus was one and one-half months and the maximum thirty months.

In every patient with tinnitus (50 per cent of the entire group) there was loss of hearing in the higher frequencies (2,048 to 11,584 cycles

per second). Since the speech range, of 300 to 2,000 cycles per second is much less affected, the degree of impairment is not readily appreciated by the person concerned. Indeed when the man himself begins to notice difficulty in hearing there is but little left. Furthermore, the loss is so gradual that he fails to understand what is happening to him and rarely presents himself for examination before extensive

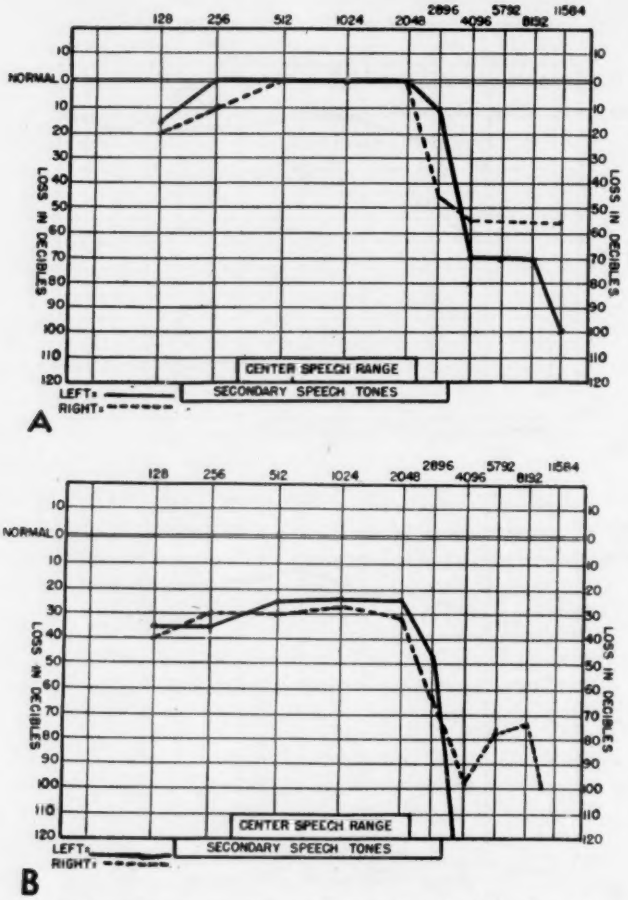

Chart 2.—Audiograms on gunnery range captain: *A*, at the time of removal from range duty; *B*, six months later.

damage has occurred. To prevent this, routine examinations must be conducted.

A 29 year old white gunnery range captain complained of progressive deafness and persistent tinnitus.

He had been assigned to a shotgun range on Oct. 26, 1943, where he served eight hours a day six days a week for fifteen months. Prior to entry to active duty he had hunted and shot skeet but stated the belief that his hearing was

normal in every respect, and it was found to be so when tested by whispered and spoken voice at a distance of 20 feet (6 meters). An audiogram was not made at that time. In the first three months of his assignment to the range he began to have intermittent tinnitus, which was severest at the end of the day. The tinnitus would disappear during the night at first but within five months became continuous. He was not aware of being deaf at that time.

With continued service on the range this tinnitus became more intense, and he said that he was surprised that others, who were standing close to him, could not hear it, for it sounded so loud to him. He even stated the belief that this buzzing had awakened him while sleeping. He planned to be a professional shot after the war and tended to minimize his difficulties, since he wished to continue on the range. He had used cotton wadding ear plugs continuously and tried to stay as far distant from the firing as he could and still perform his duties. Despite these precautions there was progressive damage, and he was removed from the range in January 1945, after fifteen months of service.

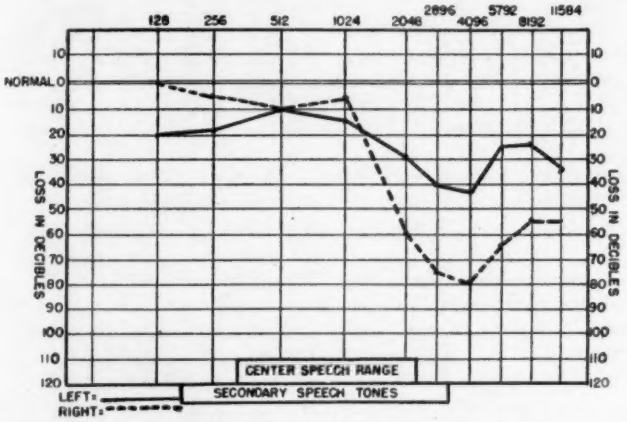

Chart 3.—Audiogram on a corporal after six weeks on the range. Such rapid deterioration is uncommon. There was ringing in the ears. He used cotton as an ear plug.

In the six months following reassignment, there has been no improvement; in fact, audiograms show some increase in damage. The tinnitus persists and is as intense as it ever was, and he cannot comprehend ordinary conversation except under ideal conditions, i. e., minimal outside interference. The patient is unable to determine to his own satisfaction whether the noise of firing or the muzzle blast has been responsible for his difficulty but is convinced that the use of a "compensator" causes added insult (chart 2).

There is a pronounced individual variation in susceptibility. In only 5 men with an average of eight and one-half months' exposure were there no symptoms of any kind and normal hearing. In the remaining 95 (95 per cent) there were varying degrees of impairment. The amount of damage, however, could not be correlated to the length of exposure. The time necessary to produce symptoms and damage to hearing was likewise subject to wide individual variation. In 1

instructor continuous severe tinnitus and pronounced loss of hearing developed within six weeks (chart 3). Such a rapid onset was unusual, and damage usually required an exposure of several months. After ten to twelve months on the range the impairment in hearing seems to

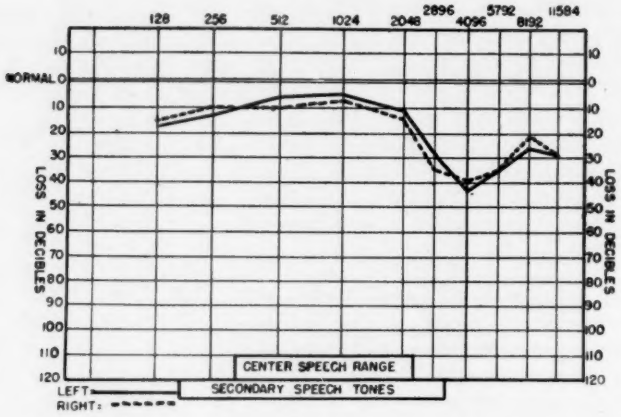

Chart 4.—Average loss of hearing in 32 instructors with service of over one year on the range.

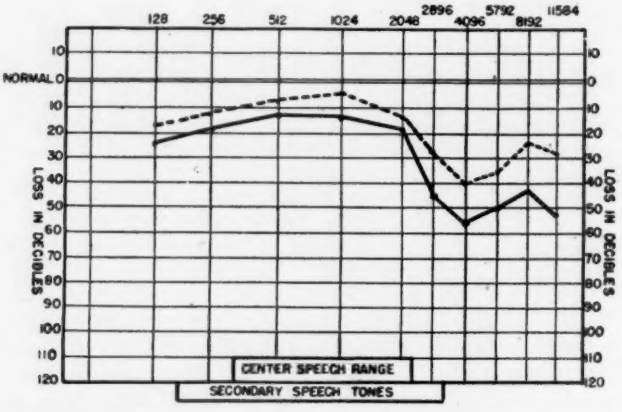

Chart 5.—Comparison of average audiograms for right ears of persons exposed to machine gun fire (34 cases) and shotgun fire (7 cases). Continuous line indicates shotgun fire, and broken line indicates machine gun fire.

become stabilized, and further loss of hearing thereafter occurs slowly if at all (chart 4). This, unfortunately, is not true of tinnitus, for the longer the service on the range the greater the possibility of the development of tinnitus and the severer it becomes.

The loss of hearing occurred on both the .50 caliber machine gun ranges and the shotgun ranges and seemed somewhat greater on the

shotgun ranges, but the differences are so small that they may not be significant (chart 5).

This loss of hearing is apparently permanent for six months after the patient's removal from duty on the range; follow-up examinations have failed to show significant improvement.

CONCLUSIONS

1. The noise of gunfire produces a definite loss of hearing, beginning in the high tones (2,048 to 11,584 cycles per second), among gunnery instructors. When severe, all tones are affected. There was wide variation in individual susceptibility in this group.

2. The average loss of hearing for both ears in the gunnery instructors in this group was 20 decibels. The length of exposure necessary to produce damage also varies widely from person to person. After ten to twelve months of service on the range, further deterioration occurred slowly if at all.

3. Tinnitus of varying degree was a complaint in 50 per cent of the subjects examined and was the most annoying symptom noted.

4. Since this damage occurs insidiously and since damage to the conversational range is late, few persons appreciate their handicap until it is far advanced and fail to request medical attention. Routine prearranged surveys are necessary.

5. Cotton plugs in the external auditory canal have not been effective in preventing loss of hearing due to the noise of gunfire.

6. There has been no significant improvement six months after cessation of exposure to the noise of gunfire, and it is believed that the loss of hearing will be permanent.

7. The efficacy of various protective devices is being investigated and will form the basis of a subsequent report.

TUBERCULOSIS OF THE TONSILS

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THE PALATINE, or faucial, tonsils are paired structures lying in a fossa bounded by the palatine arches, or pillars. At about the third month of fetal life epithelial projections grow into the tonsils from the fossae and form a complex system of crypts. Cellular debris or secretion may collect within these crypts to form firm plugs of cholesteatomatous material. The blood supply is extensive, all branches being derived from the external carotid artery. They include the dorsalis linguae from the lingual artery, the ascending palatine and tonsillar from the external maxillary artery, the ascending pharyngeal from the external carotid artery and the descending palatine from the internal maxillary artery. The pharyngeal plexus empties into the internal jugular vein by way of the pharyngeal vein and into the external jugular vein by way of the posterior palatine vein to the pterygoid plexus. Lymphatic vessels are likewise fairly extensive. Efferent vessels from the tonsils empty into the deep cervical nodes.

In view of their complex cryptic structure, extensive blood supply and lymphatic connections, tonsils affected by tuberculosis may have serious potentialities. Opinions on this score vary widely. Thus Strassmann,[1] Wood,[2] Mullin,[3] MacCready[4] and Brown[5] denied all clinical importance to tuberculosis of the tonsils. Aronheim[6] was of the opinion that the finding of tuberculosis in a tonsil on microscopic examination may lead to the discovery of an active tuberculous process elsewhere in the body in some cases, and thus he attached an indirect importance to tuberculosis of the tonsil. Newhart, Cohen and Van

1. Strassmann, F.: Ueber Tuberkulose der Tonsillen, Virchows Arch. f. path. Anat. **96**:319-324, 1884.

2. Wood, V. V.: The Tonsil in Tuberculosis, J. Missouri M. A. **29**:291-294, 1932.

3. Mullin, W. V.: An Analysis of Some Cases of Tubercles in the Tonsils, J. A. M. A. **80**:1211-1213 (April 28) 1923.

4. MacCready, P. B., and Crowe, S. J.: Tuberculosis of the Tonsils and Adenoids, Am. J. Dis. Child. **27**:113-138 (Feb.) 1924.

5. Brown, E. H.: Tuberculosis of the Tonsil, Southwestern Med. **23**:260-263, 1939.

6. Aronheim, J. H.: Tuberculous Tonsillitis, Laryngoscope **48**:794-759, 1938.

Winkle [7] stated that "The tuberculous patient whose progress toward recovery is hindered by pathology of the tonsils should not arbitrarily be denied the benefits of a tonsillectomy because he has tuberculosis." Long and his associates,[8] in a comprehensive study based on two thousand unselected pairs of tonsils from routine tonsillectomies, pointed out the high incidence of tuberculosis of the tonsils in cases of pulmonary tuberculosis and stated the belief that in the course of the disease the great majority of and perhaps all patients with progressive pulmonary tuberculosis have tuberculosis of the tonsils.

Historically, tuberculosis of the tonsils was recognized even before the isolation of the tubercle bacillus. Clinically, the entity, as pointed out by Newhart, was described by Cornil [9] in 1875 and by Deplous [10] in 1878. They described frank ulcerations of the tonsils and pharynx. Orth [11] in 1879 produced tuberculosis of the tonsils and cervical lymph nodes in rabbits by feeding them tuberculous tissue. Following these early studies, reports were concerned largely with the incidence of tuberculosis of the tonsils in routine tonsillectomies and in patients with pulmonary tuberculosis. Thus, Wood [12] in 1905 reported on 1,671 tonsillectomies in apparently nontuberculous patients and found an incidence of tuberculous lesions of 5.2 per cent. Sewall [13] in 1911 and Crowe [14] in 1917 reported 6.2 per cent and 4.6 per cent respectively. Wilkinson,[15] in a series of 10,000 cases, reported in 1929 an incidence of tuberculous lesions of 0.5 per cent on microscopic examination. Rather,[16] in 1943, reporting on 19,000 tonsillectomies done from 1922 to 1941, reported an incidence of 0.18 per cent.

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7. Newhart, H.; Cohen, S. S., and Van Winkle, C. C.: Tonsillectomy in the Tuberculous, Ann. Otol., Rhin. & Laryng. **43**:769-776, 1934.

8. Long, E. R.; Seibert, M. V., and Gonzalez, L. M.: Tuberculosis of the Tonsils, Arch. Int. Med. **63**:609-625 (April) 1939.

9. Cornil, J., 1878; cited by Friedmann, F. F.: Beitr. z. path. Anat. u. z. allg. Path. **28**:66, 1900.

10. Deplous J.: De la tuberculose de l'arrière bouche, Thesis, Paris, 1879; cited by Morris, A. G.: Clinical and Pathologic Study of Tonsil Cases, Ann. Otol., Rhin. & Laryng. **32**:864-874, 1923.

11. Orth, J.: Experimentelle Untersuchungen über Futterungstuberkulose, Virchows Arch. f. path. Anat. **76**:217, 1879.

12. Wood, G. B.: The Significance of Tuberculous Deposits in the Tonsils, J. A. M. A. **44**:1425-1434 (May 6) 1905.

13. Sewall, E. C.: Histologic Examination of the Faucial Tonsils with Reference to Tuberculosis, J. A. M. A. **57**:868-871 (Sept. 9) 1911.

14. Crowe, S. J.; Watkins, S. S., and Rotholz, A. S.: Relation of Tonsillar and Nasopharyngeal Infection to General Systemic Disorders, Bull. Johns Hopkins Hosp. **28**:1-63, 1917.

15. Wilkinson, H. F.: Pathologic Changes in Tonsils, Arch. Otolaryng. **10**: 127-151 (Aug.) 1929.

16. Rather, L. J.: Tuberculosis of the Tonsils, Am. J. Path. **19**:725-733, 1943.

As is to be expected in patients with pulmonary tuberculosis, the incidence of tuberculous involvement of the tonsils is much higher. Estimates vary between 40 and 70 per cent. MacCready and Crowe found lesions in 48 per cent of patients with tuberculosis of the cervical lymph nodes. While the percentage showing latent involvement of the tonsils is high and is discovered only by microscopic examination, clinical tonsillar tuberculosis is relatively infrequent. Thus, Brown reported 1 case in a group of 510 cases, and Long pointed out that in the clinic at the Henry Phipps Institute of the University of Pennsylvania, where 500 patients are seen annually, all of whom are given careful examinations of the nose and throat, macroscopic disease is almost never seen. At this center, where the census of in-patients during the past nine months has consistently run well over 1,000, I can recall 3 cases.

The pathogenesis of tonsillar tuberculosis is a moot point. A distinction is usually attempted between primary involvement, by way of inspired air or the alimentary canal, and secondary involvement, by way of the blood stream, lymph or sputum. Long stated that in his series of 81 patients with tonsils showing tuberculosis on microscopic examination roentgenograms of the chest were secured on 35. Sixteen of them showed active pulmonary tuberculosis of the adult type and 2 of the childhood type. The lesions in these 18 were cryptal and more extreme than in the rest of the 35 patients. It was felt, on the basis of their appearance, that direct infection had occurred from sputum from the associated pulmonary lesion. However, the cases of tonsillar tuberculosis in patients with negative sputums were similar in character to those in patients with open lesions, so that it was concluded that "the mechanism of infection of the tonsils in cases of pulmonary tuberculosis remained unproved."

Particular interest was occasioned by two types of cases in which tonsillectomy was done at this hospital. One was that of a patient whose pulmonary disease seemed arrested or well on the way to arrest, who showed symptoms of the throat, of tonsillar origin, much the same as those in a nontuberculous patient. The other was that of a patient with positive sputum in whom no parenchymal focus could be demonstarted roentgenologically and in whom no tracheobronchial lesions could be found bronchoscopically.

The possible hazard of tonsillectomy in these patients was carefully considered, and the view of Long and his colleagues [8] was subscribed to. They felt that operation exposes the patient to no undue danger of spread but rather reduces symptoms caused by absorption from tuberculous foci. Thus far, tuberculosis of the tonsil, unilateral or bilateral, has been demonstrated in 4 of the cases in which tonsillectomy was done. These are reported in detail.

REPORT OF CASES

CASE 1.—A 19 year old Negro youth, A. A., was admitted to the hospital at Oteen, N. C., on Sept. 2, 1944. The onset of his illness was in June 1944, when, following an infection of the upper respiratory tract, roentgenograms of the chest showed evidence of pulmonary disease. Sputum was positive for acid-fast bacilli. The patient complained of slight thoracic pain. The family history was noncontributory, and the patient recalled none of the usual childhood diseases. Antisyphilitic therapy had been administered prior to the patient's admission to the hospital. Physical examination disclosed a well developed and well nourished youth, with no abnormal findings generally or in the chest, except for slight dulness at the apex of the left lung. He was afebrile, the complete blood count was within normal limits, a complement fixation test was 2 plus and a precipitation test for syphilis 3 plus, the urine showed no abnormalities and sputums were persistently positive for acid-fast bacilli. The first certified sputum, on Sept. 5, 1944, showed a Gaffky count of 7. This was followed by counts of 4 plus, 3 plus and 6 plus.

The sedimentation rate after sixty minutes was 16 mm. on Sept. 4, 1944 and 4 mm. on April 28, 1945.

The report of roentgenologic examination stated, "There is a small amount of fibroid deposit, which appears to be fairly well organized in the apex and subclavicular region of the left lung." This picture, on April 27, 1945, represented resolution of the original soft lesion in the apex of the left lung noted on previous roentgenograms. Despite this evidence of clearing on roentgenograms, sputum remained persistently positive.

Phreniclasia was done on Oct. 5, 1944 and again on Nov. 30, 1944, but paralysis of the diaphragm could not be achieved. Bronchoscopy on April 20, 1945 showed a normal tree.

Antisyphilitic therapy was administered during the period of hospitalization.

The veteran complained of an occasional sore throat, and, although the tonsils presented no abnormal findings clinically, tonsillectomy was considered advisable in view of the persistent positive sputum in the face of an apparently resolving parenchymal lesion and a normal tracheobronchial tree. This was done on May 7, 1945 by the dissection and snare method, with an uneventful convalescence. The fossae healed rapidly and well. Three sputums thereafter, including two seventy-two hour concentrates, showed no acid-fast bacilli.

On microscopic examination of the tonsils, typical tubercles with giant cells of the Langhans type were seen.

The patient is in excellent condition clinically and is being continued for the present on infirmary status.

Comment.—This is a case of pulmonary tuberculosis, moderately advanced, having a degree of activity of 2 slight, with persistently positive sputum despite apparent resolution of the pulmonary lesion. Pathologic examination following tonsillectomy revealed latent tuberculosis of the tonsils. Sputums have remained negative since, and the general condition of the patient is excellent.

CASE 2.—A 28 year old white man, M. K., in the hospital at Oteen, N. C., since April 30, 1944, was found to have active pulmonary tuberculosis in February 1944. Sputums then were frankly positive for acid-fast bacilli. Examination revealed a well developed and well nourished white man, who was not acutely ill. Physical findings were essentially normal. Roentgenograms of the chest revealed a soft lesion in the apex and immediate subclavicular region of the right lung. Subsequent roentgenograms showed progressive resolution of the lesion and plani-

grams revealed no evidence of cavity. On April 19, 1945 a small area of fibroid deposit remained in the apex of the right pulmonary field. Sputums were positive for acid-fast bacilli.

Bronchoscopy revealed a normal tracheobronchial tree.

The tonsils showed no changes characteristic of tuberculosis, but in view of the positive sputum, for which there was no apparent source, tonsillectomy was done on May 16, 1944. The operation and postoperative course were uneventful except for a transient elevation of temperature to 101 F. for a single reading on May 19, 1945 and oozing from the right fossa on May 21, 1945, which was readily controlled by the local application of tannic acid and epinephrine.

The patient has gained weight steadily, and a seventy-two hour concentrate on June 7, 1945 was negative for acid-fast bacilli.

Microscopic examination of the tonsils revealed typical tubercles and giant cell formation in one of the tonsils.

Comment.—As in the first case, sputums remained persistently positive for acid-fast bacilli despite a controlled pulmonary lesion and a normal tracheobronchial tree. Latent tuberculosis of the tonsils was noted on microscopic examination following tonsillectomy. The operation was well tolerated, and a seventy-two hour concentrate thereafter was negative for acid-fast bacilli.

CASE 3.—In a 25 year old Negro man, W. L. B., cough, fever and malaise developed in March 1944. Sputums were negative for acid-fast bacilli, and roentgenograms revealed mottling in both pulmonary fields. In April 1944 observation at a Naval hospital revealed bilateral infiltration with hilar adenopathy. Sputums and gastric lavages remained negative. Cervical lymphadenopathy was noted in August, and biopsy was reported to reveal tuberculosis. Loss of 20 pounds (9.1 Kg.) was noted prior to the patient's admission to the Veterans Administration Facility on Dec. 17, 1944. Physical examination revealed a few small, BB-sized glands in each supraclavicular, epitrochlear and inguinal area. They were of shotty consistency.

Several roentgenograms were similar in appearance and showed a "fibronodular deposit widely scattered throughout both lungs. This was predominant in the hilar and perihilar regions, where there may have been a small amount of associated exudate. There was also some enlargement of the peribronchial glands in both lungs." Casual specimens, concentrates and cultures of sputum were negative. The course was afebrile throughout. The sedimentation rate was 16 mm. in sixty minutes. Tuberculin given intracutaneously, 0.1 cc. (0.00002 mg. of old tuberculin), gave a slightly positive reaction. Urine and hematologic findings were within normal limits. Blood precipitation and complement fixation tests for syphilis gave negative reactions.

Bronchoscopy showed a normal tracheobronchial tree.

The patient was referred to the eye, ear, nose and throat service for biopsy of a tonsil, inasmuch as the cervical glands were too small to excise. Boeck's sarcoid was suspected. It was felt that complete tonsillectomy and microscopic examination would be preferable to biopsy. Tonsillectomy was carried out on Feb. 28, 1945, without incident, and the patient had an uneventful convalescence. The patient began to gain weight shortly thereafter and has gained 15 pounds (6.8 Kg.) to date. He has remained afebrile, the sputums have continued negative and his general condition and morale have improved remarkably.

A pathologic report showed "numerous typical tubercles, of which some have central caseation," and the microscopic diagnosis was "hyperplastic tuberculous tonsillitis."

Comment.—In this case tonsillectomy was done to investigate the possibility of Boeck's sarcoid, and the diagnosis of latent tuberculosis was established. Sputums were negative, and the tracheobronchial tree was normal. Roentgenologic changes, however, raised the question of sarcoidosis. It is interesting to note that clinical improvement and gain in weight began directly after tonsillectomy.

CASE 4.—C. L. C., a 22 year old white man, first became aware of his pulmonary tuberculosis in September 1942, when sputums were found to be positive for acid-fast bacilli. Pneumothorax on the left side was instituted Nov. 16, 1942, and phreniclasia on the left side was done Feb. 15, 1943. The patient was admitted to this hospital June 9, 1943, complaining of productive cough. Physical examination revealed a well developed and well nourished white man, not acutely ill. Abnormal findings were confined to the left side of the chest, where breath sounds were absent, as was to be expected in view of the artificially induced pneumothorax and the presence of a pleural effusion. Thoracenteses were done and pneumothorax continued. The last positive sputum was noted June 15, 1943. All sputums thereafter were negative. Inoculation of a guinea pig gave a positive reaction on October 22, and culture on December 9 was sterile. Negative sputums also included casual specimens and twenty-four hour and seventy-two hour concentrates.

Graduated exercise was begun on May 2, 1945 and continued to date, and progress has been uninterrupted, so that the patient now takes one hour of walking daily.

Roentgenograms of the chest showed a normal right lung and hydropneumothorax on the left, with complete collapse of the lung.

The patient was seen Jan. 12, 1945 in the eye, ear, nose and throat clinic, complaining of frequent, persistent, recurrent sore throats. The nasopharynx and larynx were normal, but the tonsils were hypertrophied and foul, sebaceous, purulent material was expressed from the crypts. A tonsillectomy was considered advisable and, with the concurrence of the thoracic disease service, was done Feb. 7, 1945. Microscopic examination of one of the tonsils revealed typical tubercles with central giant cells of the Langhans type surrounded by a zone of epithelioid cells, around which was a collar of lymphocytes. The pathologic diagnosis was chronic tuberculous tonsillitis.

The operation and postoperative course were uneventful, the fossae healing without incident. The condition is now well on the way to a state of arrest.

Comment.—This case, like the previous one, showed latent tuberculosis of the tonsils, with a persistently negative sputum. Conversion had occurred after pneumothorax. Tonsillectomy was uneventful, relieved the patient of symptoms referable to his throat and did not disturb his progress toward arrest.

GENERAL COMMENT AND SUMMARY

Tonsillectomy was done at this hospital in patients with arrested or almost arrested pulmonary disease who showed indication for the procedure, such as nontuberculous patients and patients who showed positive sputums for which no parenchymal, tracheobronchial nasopharyngeal or laryngeal source could be demonstrated. In the patients with microscopic evidence of tonsillar tuberculosis there were no clinical manifestations. The tonsillar involvement was of the "latent" type. In the 2 patients with positive sputums, the sputums converted immediately postoperatively, so that it is strongly suspected that the tonsils may

have been the source. In 1 of the patients with negative sputums tonsillectomy and microscopic examination established the diagnosis of tuberculosis beyond a doubt. The pulmonary lesion had previously been considered evidence of sarcoidosis. Tonsillectomy in the veteran receiving pneumothorax led to the elimination of an additional tuberculous focus, which conceivably might have been a source of reactivation at a later date.

Operation in all cases was attended by no unusual difficulty, healing was uneventful and in at least 3 of the 4 cases in which a positive diagnosis of tuberculosis was made clinical improvement followed immediately on tonsillectomy. The fourth patient progressed uninterruptedly on the road to arrest of his pulmonary disease.

Tonsillectomy in the patients chosen for the indications described presented no hazard and led to the eradication of a tuberculous focus. It is not unlikely that an acute tonsillar infection, particularly of the follicular type or, if associated with abscess formation, in a tonsil containing tubercles, might lead to the ultimate dissemination of the disease. Clean enucleation (all operations were done by the surgical method of dissection and completed with the snare) eliminates this possibility. In any circumstances it would appear wise to eradicate a tuberculous focus where feasible and where there is no likelihood of any deleterious effect on the general condition of the patient.

From the standpoint of pathogenesis, the 2 patients with negative sputum are worthy of note. One of them never at any time had a history of positive sputum, although the likelihood of its having been positive prior to the time the patient came under controlled observation should be considered. The second patient showed a positive sputum, with ultimate conversion prior to tonsillectomy. It may therefore be postulated, as for the 2 patients with positive sputum at the time of tonsillectomy, whose original lesions had resolved to the point where it was no longer felt that parenchymal disease accounted for the acid-fast bacilli in the sputum, that the tonsils had become involved by implantation of expectorated acid-fast bacilli which had remained there after resolution of the pulmonary process. Had these 3 patients come to tonsillectomy without prior knowledge of their pulmonary disease, it might have been supposed, perhaps wrongly, that they were patients with primary tonsillar tuberculosis or tonsillar tuberculosis of hematogenous origin.

Valuable aid was contributed by Major R. J. Rogers, who examined the sections of tissue, and by Capt. D. S. Bolstad and Lieut. W. H. Tyler, who participated with me in the surgical procedures.

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PENICILLIN ADMINISTERED LOCALLY IN TREATMENT OF DISEASE OF NASAL ACCESSORY SINUS

Evaluation of Bacterial Sensitivity

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CHEMOTHERAPEUTIC agents and antibiotics have been undergoing clinical research to determine the extent of their usefulness in the local treatment of disease of the accessory sinuses. There has been much encouragement, and penicillin, especially, seems to show even wider clinical usefulness in the control of specific bacteria.[1] This investigation undertakes to determine the value of the bacteriologic tests for sensitivity to penicillin in indicating which infections of the mucosa of the nasal sinus can be expected to respond to local penicillin therapy. Morphologically and culturally identical organisms vary considerably in their sensitiveness to penicillin.[2] Putney [3] reported 9 cases of sinus disease with severe complications in which good results were obtained by combining general and local administration of sulfadiazine and penicillin with surgical treatment. Sensitivity tests were not reported. Sale and Diamond [4] used a needle fixed in the antrum in 1 case for local instillation of penicillin, but sensitivity tests were not done. The follow-up in some of the cases of this series was limited. However, treatment in many cases was long enough to give definite indications of results of local penicillin treatment of sinus disease.

PRINCIPLES FOLLOWED

The method of attack in this series follows suggestions of Crowe, Fisher, Ward and Foley.[5] Qualitative tests for sensitivity to penicillin

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(Footnotes continued on next page)

TABLE 1.—*Summary of Results*

Case No.	History: First Attack	History: Other Attacks	History: Chronic from Year	Transillumination: Frontal Right	Transillumination: Frontal Left	Transillumination: Antrums Right	Transillumination: Antrums Left	Culture	Penicillin Sensitivity (Units)	Polypi
1	..	..	Many years	..	..	..	+	Nonhemolytic staphylococcus	Not sensitive	..
2	..	..	Years	..	..	..	+	Hemolytic staphylococcus, coagulase positive	Sensitive	..
3	..	..	Years	+	..	+	..	No growth	.....	..
4	..	..	7 yr.	..	..	+	..	Hemolytic staphylococcus, coagulase positive	Sensitive	..
5	..	..	Lifetime	+	+	+	+	Mixed organisms	.....	..
6	..	..	Years	+	+	+	+	Mixed organisms	.....	+
7	..	..	Years	+	..	..	..	No growth	.....	..
8	Acute	..	..	..	..	..	+	No growth	.....	..
9	..	..	Years	..	+	..	+	Nonhemolytic streptococcus	.....	..
10	..	..	Years	+	+	+	+	No growth	.....	..
11	..	..	+	..	..	..	+	Beta hemolytic streptococcus	Sensitive	..
12	Acute	..	..	..	..	+	..	No growth	.....	..
13	..	..	+	+	+	+	+	Alpha streptococcus	.....	..
14	Feb. 1944	..	..	+	..	+	..	No growth	.....	..
15	..	..	+	..	..	+	+	Hemolytic staphylococcus	Sensitive	+
16	..	..	Years	+	+	+	+	No growth	.....	..
17	..	..	10 yr.	..	..	+	+	No growth	.....	..
18	..	..	Years	..	..	+	..	Hemolytic staphylococcus	Sensitive	..
19	..	..	+	..	..	+	+	No growth	.....	..
20	1935	1944	1935	..	..	+	+	Staphylococcus albus	Sensitive to 1	..
21	1945	..	..	..	..	+	+	No growth	.....	..
22	1923	..	1923	..	..	..	..	Few Staph. aureus, few Hemophilus	Not sensitive	..
23	Jan. 1, 1945	..	..	..	..	+	+	Four cultures, no growth	.....	..
24	Acute	..	..	..	..	+	+	Five cultures, no growth	.....	..
25	Acute	..	..	..	..	+	+	Neisseria sicca	Sensitive to 5	..
26	Acute	..	..	..	..	..	+	No growth	.....	..
27	1930	..	1930	..	..	+	..	Staphylococcus albus	Sensitive to 0.005	..
28	Acute	..	..	..	..	+	..	No growth	.....	..
29	Jan. 5, 1945	..	..	..	..	+	..	Staphylococcus albus, slightly hemolytic	Sensitive to 0.05	..
30	Acute	..	+	..	..	..	..	Few nonhemolytic streptococcus	Sensitive to 0.5	..
31	..	..	+	..	..	+	..	Nonhemolytic streptococcus	Sensitive	..
32	Acute	..	..	+	..	+	..	Many pneumococci	Nonviable	..
33	1940	Severe	1940	..	..	..	+	Alcaligenes	Not sensitive	..
34	..	Severe	Years	..	+	+	+	Pneumococcus	Sensitive to 0.0005	..
35	Acute	..	..	..	..	..	+	Pneumococcus and staphylococcus	Both sensitive to 0.05	..
36	..	..	6 yr.	..	..	+	+	1. Staphylococcus 2. Streptococcus, grade A, beta hemolytic	1. Not sensitive 2. Sensitive to 0.005	..
37	..	..	Years	+	+	+	+	No growth	.....	..
38	..	..	+	+	..	+	+	No growth	.....	+
39	Acute	..	..	..	..	+	+	No growth	.....	..
40	..	..	1928	..	..	+	..	Hemolytic Staph. aureus	Sensitive to 0.5	..
41	Acute	..	..	..	..	+	+	Hemolytic Staph. aureus	Sensitive to 5	..
42	Acute	..	..	..	..	+	..	Hemolytic Staph. aureus	Sensitive to 0.16	..
43	Acute	..	..	..	..	+	..	Beta hemolytic, group A streptococcus	Sensitive to 0.005	..
44	..	..	Aug. 1944	..	..	+	..	Miscellaneous contaminants	.....	..
45	Acute	..	..	..	..	+	..	No growth, foul pus	.....	..
46	Acute	..	..	..	..	+	..	Streptococcus viridans, pure culture	Sensitive to 0.16	..
47	Acute	..	..	..	..	+	..	Actinomyces	.....	..
48	..	..	10 mo.	..	..	+	..	Overgrowth of B. pyocyaneus	.....	..
49	Acute	..	..	..	..	..	+	Alpha prime streptococcus, diphtheroids	.....	..
50	Acute	..	..	..	..	+	..	No growth	.....	..
51	Acute	..	..	..	..	..	+	Flavobacterium (nonpathogenic)	.....	..
52	Acute	..	..	..	..	..	+	No growth	.....	..
53	Acute	..	..	..	..	..	+	No growth	.....	..
54	Acute	..	..	..	..	+	..	No growth	.....	..
55	..	..	+	+	+	+	+	Hemolytic Staph. aureus, not inhibited	Not sensitive	+
56	April 5, 1945	..	..	..	..	..	+	No growth	.....	..
57	..	..	Years	..	..	+	..	Beta hemolytic streptococcus, group F	.....	..
58	..	..	..	..	..	+	..	No growth	.....	..
59	..	..	Years	..	..	+	+	B. pyocyaneus	.....	..
60	Feb. 1945	..	..	..	..	+	+	Beta hemolytic streptococcus	Sensitive to 0.005	..
61	Acute	..	1922	..	+	+	+	Staph. aureus	Sensitive to 5	..

* This table has been taken from an official photograph by the United States Army Air Corps.

Date of First Treatment	Treatment: Total Number of Clinic Visits	Treatment: Penicillin Instilled	Treatment: Last Treatment Date	Results: Cured	Results: Improved	Results: Unimproved	Complications
1/11/44	9	2	2/22/44	..	+	..	Sinus looks perfect, but patient complains of persistent postnasal drop
2/ 5/44	6	5	2/17/44	..	+	..	Clinically well but pus in sinus
1943	30 - 50	10	1945	..	..	+	Subsequently radical operation done on frontal sinus but antrum unimproved; given medical discharge (C.D.D.)
1/22/43	6	3	2/10/45	+	..	..	Washed clear; antrum held 11 cc., result of thickened membrane
.....	30	5	.....	..	..	+	Had pansinusitis; right Caldwell-Luc performed and patient then given C. D. D.
3/ 3/43	20	10	8/15/44	..	..	+	Patient had pansinusitis, hypertrophic membrane with polyps; Proetz treatment with penicillin
.....	5	2	3/27/44	..	+	..	Rhinitis sicca; postnasal drop
3/24/44	5	1	4/10/44	+	..	..	Patient neuropsychiatric; hospitalized; intranasal approach to antrum
3/14/43	37	3	12/ 7/44	+	..	..	Neuropsychiatric complication; no recurrence since serving with overseas unit
11/22/43	15	3	6/ 4/44	..	+	..	Chronic pansinusitis; antrums washed (no organisms) 4/29/44 but still has trouble; psychoneurosis
.....	6	1	.....	+	..	..	Type of recurrent, acute disease
4/14/44	5	1	8/ /44	..	+	..	Acute rhinitis; symptoms for 3 weeks; acute pain in left antrum after flying, 4/11/44
3/10/44	20	4	8/ /44	..	..	+	Pansinusitis, atrophic rhinitis; Proetz treatment given
4/ 2/44	15	4	7/30/44	+	..	..	Apparent response to penicillin
6/27/44	R 35, L 35	R 3, L 1	4/11/45	..	+	..	Polyps removed, bilateral; patient hospitalized; Proetz treatment with penicillin and intramuscular injection of penicillin
6/ 7/44	20	..	8/14/44	..	+	..	Hospitalized, 15 or more Proetz treatments with penicillin
7/21/44	8	4	8/10/44	+	..	..	Still complains of inability to work; sinus trouble has been excuse from work for 10 years
6/14/44	7	3	9/17/44	+	..	..	Antrum washes clear; holds 15 cc.; transillumination; slightly darker; patient states "my nose does not bother me at all"
8/29/44	21	4	9/ 9/44	..	+	..	Hospitalized 6/6/44; left Caldwell-Luc performed; slight ethmoiditis; qualified for overseas duty
7/ /44	Over 50	Many	6/ /45	..	..	+	Bilateral Caldwell-Luc performed, with improvement
5/ 5/45	..	3	4/ 7/45	+	..	..	Transillumination clear
1/ 3/45	3	3	1/23/45	..	+	..	Hospitalized 7 days; needles in place for 2 or 3 days; condition recurrent
2/10/45	6	6	3/13/45	..	..	+	Hospitalized; constitutional psychopathic state, inadequate personality; given C. D. D.
2/ 6/45	4	4	2/20/45	+	..	..	Antrums washed clear; disease in right and left sinuses cured
12/26/44	6	5	1/12/45	+	..	..	Antrums washed clear
2/ 5/45	4	3	2/12/45	+	..	..	
12/19/44	..	1	12/23/45	..	..	+	Hospitalized; severe allergy
12/13/45	2	1	2/22/45	..	+	..	Pronounced improvement
1/16/45	2	1	1/28/45	+	..	..	Cured in one wash
1/ 9/45	4	2	1/17/45	..	+	..	Blockage of ostium; antrum washed with difficulty
11/ 3/44	6	1	1/15/45	..	+	..	Treated in allergy clinic; sinus condition recurred
12/18/44	3	2	1/ 2/45	+	..	..	
12/ 8/44	10	4	4/ 4/45	+	..	..	Subsequent acute rhinitis cleared up by general treatment without recurrence
1/ 6/45	8	2	1/23/45	+	..	..	Had recurrent trouble; refused washes after second; transillumination clear
11/27/44	4	1	1/20/45	+	..	..	Complicated by acute tonsillitis; tonsillectomy 1/10/45
12/ 4/44	8	6	6/ 5/45	+	..	..	Condition recurrent; hospitalized 10 days, with needles in antrum 5 days; transillumination clear
2/10/45	10	3	3/22/45	..	..	+	Hospitalized; allergic asthma; many treatments; given C. D. D.
2/13/45	3	1	3/17/45	..	..	+	Pansinusitis; polyp removed
2/13/45	3	2	2/17/45	+	..	..	
2/14/45	4	1	2/22/45	..	+	..	Condition subsequently treated as allergy
2/15/45	2	2	2/20/45	+	..	..	
5/17/45	6	2	5/29/45	+	..	..	
2/ 1/45	2	2	2/15/45	+	..	..	
1/28/45	8	5	8/ 2/45	+	..	..	Type of chronic disease; may show recurrence
4/19/45	8	4	5/15/45	..	+	..	Complicated by acute tonsillitis
2/14/45	5	2	2/22/45	+	..	..	Antrum washed clear
3/10/45	4	3	3/22/45	+	..	..	Antrum washed clear
4/28/45	3	1	5/ 1/45	+	..	..	
3/18/45	6	3	4/27/45	+	..	..	Transillumination clear
3/12/45	3	2	3/17/45	+	..	..	
2/22/45	..	1	.....	..	..	+	Strictly allergy and neuropsychosis
12/18/45	..	1	.....	+	..	..	
3/ 5/45	..	2	.....	..	+	..	
3/15/45	3	2	4/26/45	..	+	..	
5/ 8/45	6	1	6/ 7/45	..	..	+	No improvement expected in view of extent and type of pathologic condition
4/ 7/45	2	1	4/10/45	+	..	..	
4/26/45	..	1	.....	..	+	..	
5/ 8/45	4	2	.....	+	..	..	Second recurrence
11/13/44	25	3	4/ 6/45	..	+	..	Polypectomy, cauterization, and many treatments; multiple complaints
5/29/45	4	1	6/ 7/45	+	..	..	Two washings at another hospital; 1 penicillin washing cured condition
4/16/45	5	Nose drops	4/22/45	+	..	..	160,000 units penicillin given; frontal pain; adequate maxillary surgical treatment

were run by the laboratory on all cultures showing growth, and quantitative sensitivity tests were done in the cases at Drew Field.[6]

BACKGROUND OF SERIES—SIXTY-ONE CASES

This investigation covers 61 patients treated during a period of two years, 1943-1944 at MacDill Field Station Hospital, and 1944-1945 at Army Air Forces Regional Station Hospital, Drew Field, both of Tampa, Fla. During these years there was no epidemic of disease of the upper respiratory tract. The total (61 cases) makes up a very small percentage of the ear, nose and throat clinic load, which was 15,265 patient visits in 1944 and 7,000 patients. It should be noted here that at MacDill Field in 1943 the limited quantity of penicillin available caused the reservation of the drug for selected cases (of chronic or acute severe infection).

It was noted that, in the army as in private practice, this condition was distinctly seasonal in nature. Even the patients with chronic infection tended to seek attention less often during the summer and fall.

TECHNIC

Culturing.—Cultures were taken by needle puncture with a 15 gage needle through the cocainized inferior meatus. The specimen occasionally dropped into the culture tube; if not, it was obtained by aspiration into a sterile syringe or by injection and withdrawal of isotonic solution of sodium chloride. This is most easily done with the head back at a 60 degree angle to puddle the liquid near the needle's point.

Treatment.—After the culture had been taken, the sinus was irrigated with about 500 cc. of isotonic solution of sodium chloride, or until it was clear, and 1 or 2 cc. of penicillin, 500 units to the cubic centimeter, was instilled. Instillations following washings were carried out on a variable procedure—never more often than every other day—usually twice a week, and frequently at weekly intervals, depending on the chronicity or the acute severity of the infection. Home treatment, with few exceptions, consisted of nose drops of 0.065 mg. of iodine, 0.2 mg. of menthol and 0.32 mg. of camphor in 30 cc. of thin petrolatum, together with instructions for general hygiene. When a patient was treated between washings he received a 5 per cent cocaine spray,

5. Crowe, S. J.; Fisher, A. M.; Ward, A. T., Jr., and Foley, M. K.: Penicillin and Tyrothricin in Otolaryngology Based on Bacteriological and Clinical Study of 118 Patients, Ann. Otol., Rhin. & Laryng. **52**:541-572 (Sept.) 1943. Crowe, S. J., and Ward, A. T., Jr.: Local Use of Sulfadiazine, Tyrothricin, Penicillin and Radon in Otolaryngology, North Carolina M.J. **4**:431-435 (Oct.) 1943.

6. Waisman, M., and Gots, J. S.: Penicillin Treatment in Topical Treatment of Pyogenic Infections of the Skin: Clinical and Laboratory Observations, Arch. Dermat. & Syph. **53**:234-242 (March) 1946.

mechanical cleansing (with suction if necessary) and occasionally 10 per cent mild protein silver (argyrol) packs. Thirteen patients were hospitalized, 4 for radical surgical treatment (cases 3, 5, 19 and 20). In cases 22 and 36 the patients received penicillin every two hours for three and five days respectively through indwelling needles in the antrum. Patient 15, recorded as having a penicillin-sensitive infection, also had polypi, and his condition was improved after polypectomy. He received

TABLE 2.—*Results in Six Cases in Which There Was Growth of Organisms Sensitive to Penicillin*

Bacteria Sensitive to 0.05 Units per Cubic Centimeter

Case Number	Acute Disease	Chronic Disease	Culture	Cured	Improved	Unimproved	Approximate Length of Treatment	Comment
27	..	+	Staphylococcus albus	..	..	+	1 wk.	Patient hospitalized for severe allergy (asthma), bacteria an incidental finding
29	+	..	Staphylococcus albus, slightly hemolytic	+	..	..	1 wk.	One treatment cured this patient
34	..	+	Pneumococcus	+	..	..	2 wks.	History of recurrent trouble; patient refused washes after second but cured after 8 visits
35	+	..	Staphylococcus, pneumococcus	+	..	..	2 wks.	Acute disease, complicated by acute tonsillitis; patient cured after 1 wash, had tonsillectomy Jan. 10, 1945
36	..	+	Staphylococcus, not sensitive; streptococcus, beta hemolytic	+	..	..	3 wks.	Staphylococcus not sensitive; Streptococcus sensitive to 0.005 unit; case of recurrent disease; patient hospitalized 10 days, with needles in antrum for 5 days
43	+	..	Beta hemolytic streptococcus, group A	+	..	..	1 wk.	Sinus washed twice before penicillin was used, with slight benefit, 1 instillation of penicillin gave prompt cure

penicillin intramuscularly without results. Patient 61, a lieutenant colonel who had had extensive successful surgical treatment in the past and whose subacute frontal sinusitis was cleared up in twenty-four hours after three weeks of discomfort, received 160,000 units of penicillin intramuscularly in twenty-four hours and was charted as cured. Several patients with chronic infections (cases 3, 7 and 14) received sulfonamide drugs and bed rest in the hospital in addition to local treatment with penicillin, without cure. A solution of penicillin was used as nose drops by patient 61, and Proetz displacement (as many as twenty treatments) was tried in cases 7, 14, 16, and 17 without discomfort and without startling improvement.

The volume of the sinus was frequently measured and checked later as an indication of cure. The instillation of penicillin was done at each washing except on a few occasions, when penicillin "washings" were not available. Details of treatment while patients were in the

TABLE 3.—*Results in Fourteen Cases in Which There Was Growth of Organisms Sensitive to Penicillin*

Bacteria Sensitive to 0.16 to 5 Units per Cubic Centimeter

Case Number	Acute Disease	Chronic Disease	Culture	Cured	Improved	Unimproved	Approximate Length of Treatment	Comment
2	..	+	Hemolytic staphylococcus, coagulase positive	..	+	..	2 wks.	Chronic for years; patient subjectively well but transillumination dark and pus still present after 5 washes
4	..	+	Beta hemolytic staphylococcus, coagulase positive	+	..	..	2 wks.	Antrum holds 11 cc.; diminished because of thickened membrane
11	..	+	Beta hemolytic streptococcus	+	..	..	3 wks.	A type of recurrent acute disease
15	..	+	Hemolytic staphylococcus		+	..	3 mos.	Removal of bilateral polyps and other intensive treatment gave some improvement; chiefly ethmoidal disease
18	..	+	Hemolytic staphylococcus	+	..	..	3 wks.	Antrum washes clear, holds 15 cc., slightly dark on transilluminations
20	..	+	Staphylococcus albus	..	..	+	1 yr.	Bilateral Caldwell-Luc operation; case of allergy for 1 year
25	+	..	Neisseria sicca	+	..	..	2 wks.	Antrum washed 5 times in 2 weeks, with cure
30	+	..	Few nonhemolytic streptococci	..	+	..	1 wk.	Improved in spite of block of ostium by 2 instillations of penicillin
31	..	+	Nonhemolytic streptococcus	..	+	..	1 wk.	History of chronic recurrent condition; patient treated in allergy clinic
40	..	+	Hemolytic Staphylococcus aureus	..	+	..	1 wk.	Case of chronic disease complicated by allergy
41	+	..	Hemolytic Staphylococcus aureus	+	..	..	1 wk.	Two instillations gave cure
42	+	..	Nonhemolytic streptococcus	+	..	..	2 wks.	Cured within 2 washes
46	+	..	Pure culture Streptococcus viridans	+	..	..	1 wk.	Antrum washed clear on second wash
61	+	..	Staphylococcus aureus	+	..	..	1 wk.	160,000 units of penicillin intramuscularly and penicillin in nose drops gave cure after 24 hours of frontal involvement of 3 weeks' duration

hospital are not recorded on the accompanying chart. The last treatment date, as recorded on the chart, frequently represents a follow-up visit after an interval of rest from treatment. The number of instillations of penicillin is a better guide to the length of time during which active treatment was required.

RESULTS

In 37 of the 61 cases there was growth of bacteria in cultures. In 21 cases the bacteria were sensitive to penicillin in the qualitative tests. Five laboratory reports show contaminants or organisms which were bacterial vagrants. It was disappointing that only half the cultures showed pathogens which were useful.

Of the cases in which bacterial growth occurred, there was prompt cure in the group of 7 cases in which the bacteria were sensitive to 0.05 units of penicillin per cubic centimeter, or less, with the exception of case 27. This patient, with a chronic disease for fifteen years, was treated principally in the hospital. Antral cultures were repeatedly negative before the Staphylococcus albus, sensitive to 0.005 unit of penicillin per cubic centimeter, was finally grown. The nasal mucosa showed severe hyperesthetic changes, and the pus in washings was scanty and mucoid. The patient was transferred to the allergy department. It is felt that the penicillin-sensitive organism in this case was an incidental finding.

In the remaining 14 cases of this "sensitive group" the bacteria were sensitive to concentrations of 0.16 unit of penicillin per cubic centimeter up to 5 units per cubic centimeter or were not tested quantitatively. Eight patients are considered cured and the condition of 5 is improved and of 1 (case 20) is unimproved. The last patient had many negative cultures and a variety of treatments. This patient was a woman dependent 36 years of age who had suffered from severe hyperesthetic rhinitis for many years. A thyroidectomy had been done; the metabolic rate was discovered to be low, and thyroid was given. The allergist cooperated in the treatment for over a year. A bilateral Caldwell-Luc operation, performed in April 1945, showed chiefly edematous mucosa. There has been some postoperative improvement. The Staphylococcus albus isolated in this case was felt to be an incidental finding.

Of the 5 patients whose condition is listed as improved in the group (cases 2, 15, 30, 31 and 40), longer observation might have permitted listing patients 2 and 30 as cured. The condition of patient 15 was notably improved in spite of the presence of polypoid degeneration, and in cases 31 and 40 there was improvement in spite of the fact that the condition occurred as a complication of allergic rhinitis.

In the cases of acute disease in which the organisms were sensitive to the penicillin test all the patients were cured except the patient in case 30, whose condition was charted improved but might have been charted cured if observation had continued.

In the cases of chronic disease 5 patients were cured and the condition of 4 was improved. In case 20 the bacteria were sensitive to penicillin, and the patient's condition was unimproved, and in case 27,

in which there was underlying allergy, the patient's condition was unimproved.

Among the cases of chronic disease in the group in which the bacteria were sensitive to penicillin, all failures to effect cures could be explained

TABLE 4.—*Acute Infection with Penicillin-Sensitive Organisms*

Case Number	Culture	0.05 or Less	0.16 to 5	Length of Treatment	Cured	Improved	Unimproved	Comment
25	Neisseria sicca	..	+	2 wks.	+	..	..	
29	Staphylococcus albus, slightly hemolytic	+	..	1 wk.	+	..	..	
30	Few nonhemolytic streptococci	..	+	1 wk.	..	+	..	Improved by 2 installations; further observation might have disclosed cure
35	Pneumococcus; staphylococcus	+	..	1 wk.	+	..	..	
41	Hemolytic Staphylococcus aureus	..	+	1 wk.	+	..	..	
42	Nonhemolytic streptococcus	..	+	2 wks.	+	..	..	
43	Beta hemolytic streptococcus, group A	+	..	2 wks.	+	..	..	
46	Pure culture Streptococcus viridans	..	+	1 wk.	+	..	..	
60	Beta hemolytic streptococcus	+	..	1 wk.	+	..	..	
61	Staphylococcus aureus	..	+	1 wk.	+	..	..	

TABLE 5.—*Chronic Infection with Penicillin-Sensitive Organisms*

Case Number	Culture	0.05 or Less	0.16 to 5	Length of Treatment	Cured	Improved	Unimproved	Comment
2	Hemolytic staphylococcus; coagulase positive	..	+	2 wks.	..	+	..	Chronic for years; subjectively well but pus in sinus
4	Hemolytic staphylococcus; coagulase positive	..	..	3 wks.	+	..	..	
11	Beta hemolytic streptococcus	..	..	1 wk.	+	..	..	
15	Hemolytic staphylococcus	..	+	3 mos.	..	+	..	Bilateral polyps
18	Hemolytic staphylococcus	..	..	3 wks.	+	..	..	
20	Staphylococcus albus	..	+	1 yr.	..	..	+	Hyperesthetic rhinitis
27	Staphylococcus albus	+	..	1 wk.	..	..	+	Hyperesthetic rhinitis
31	Nonhemolytic streptococcus	..	+	1 wk.	..	+	..	Hyperesthetic rhinitis
34	Pneumococcus	+	..	2 wks.	+	..	..	
36	1. Staphylococcus (not sensitive) 2. Streptococcus (sensitive)	+	..	3 mos.	+	..	..	
40	Hemolytic Staphylococcus aureus	..	+	1 wk.	..	+	..	Hyperesthetic rhinitis

by the fact that the sinus trouble was a complication of an underlying hyperplastic or allergic rhinitis, except in case 2, in which the patient was under observation for only a short time. It was reasonable to believe that this patient might be cured with further care.

The growths which showed definite penicillin-resistant characteristics occurred in 5 cases. This is not a large enough series to allow the formation of any conclusions. In all these cases the disease was chronic. It is interesting that the patient in case 36, in which cultures showed two organisms, was 1 of the 2 patients cured.

TABLE 6.—*Results in Cases in Which the Bacteria Were Not Sensitive to Penicillin*

Case No.	Culture	Length of Disease	Length of Treatment	Cured	Improved	Unimproved
1	Nonhemolytic staphylococcus	Many years	2 wks.	..	+	..
22	Few Staphylococcus aureus, few hemophils	22 years	3 wks.	..	+	..
33	Alcaligenes	5 years	4 wks.	+	..	..
36	1. Streptococcus, beta hemolytic (sensitive) 2. Staphylococcus (not sensitive)	6 years	6 mos.	+	..	..
55	Hemolytic Staphylococcus aureus	Years	1 mo.	..	..	+

TABLE 7.—*Cases of Acute Disease Which Did Not Show Bacterial Growth*

Case Number	Length of Disease	Length of Treatment
Cured		
8	1 month	1 week
14	6 months	3 months
21	1 month	1 month
24	1 month	1 month
26	1 month	1 week
39	1 week	1 week
47	2 weeks	2 weeks
50	1 week	1 week
52	1 week	1 week
56	1 week	1 week
58	1 month	1 week
Improved		
12	5 months	1 week
28	1 month	1 week
45	1 month	1 month
53	2 weeks	2 weeks
54	1 month	2 weeks
Unimproved		
23	3 months	3 months
51	1 month	1 week

RESULTS IN CASES IN WHICH THERE WAS NO BACTERIAL GROWTH

There are 5 cases in which contaminants or vagrant organisms were reported on culture (cases 44, 47, 48, 51 and 59). It is convenient to include this group with the 18 cases in which there was no bacterial growth.

In 13 of the cases showing no bacterial growth, the disease was acute, and in 11 it was chronic. Of the patients with acute disease 11 were cured; the condition of 5 was improved and of 2 was unimproved.

In the group of cases of chronic diseases, 3 patients were cured, the condition of 5 improved, and the condition of 3 unimproved. Of the patients whose condition was improved, patient 7 can almost be

TABLE 8.—*Cases of Chronic Disease in Which There Was No Bacterial Growth*

Case Number	Length of Disease	Length of Treatment
Cured		
17	10 years	1 month
44	1 year	3 months
48	10 months	1 week
Improved		
7	Years	2 weeks
10	Years	3 months
16	Years	2 months
19	Years	1 month
50	Years	1 month
Unimproved		
3	Years	2 years
37	Years	1 month
38	Years	1 month

moved into the cured group. Case 10 was of chronic pansinusitis; case 16 was of chronic rhinitis and pansinusitis; the patient in case 19, after a radical maxillary sinusotomy (Caldwell-Luc operation), was qualified for overseas duty. In case 3 the disease was chronic for years and was unimproved by operative procedure. Case 37, in which the

TABLE 9.—*Cases of Disease with Complications, in Which the Patient's Condition Was Improved or Unimproved*

Case No.	Acute	Chronic	Penicillin Sensitive	Not Sensitive	No Growth	Length of Treatment	Improved	Unimproved
With Hyperplastic Rhinitis and Polypi								
6	..	+	..	+	..	5 months	..	+
15	..	+	+	..	..	1 year	+	..
38	..	+	..	..	+	2 months	..	+
55	..	+	..	+	..	2 months	..	+
With Hyperesthetic Rhinitis								
13	..	+	..	+	..	6 months	..	+
20	..	+	+	..	..	1 year	..	+
27	..	+	+	..	..	1 week	..	+
31	..	+	+	..	..	3 months	+	..
37	..	+	..	..	+	1 month	..	+
40	..	+	+	..	..	1 week	+	..
51	+	..	..	+	..	1 week	..	+
59	..	+	..	+	..	5 months	+	..
With Pansinusitis								
5	..	+	..	+	..	2 years	..	+
10	..	+	..	..	+	7 months	+	..
13	..	+	..	+	..	6 months	..	+
16	..	+	..	..	+	3 months	+	..

condition was chronic for years, was a case of allergy. Case 38 was one of pansinusitis with polyps.

Cases in which the patients were not cured include 4 of disease complicated by hyperplastic rhinitis with polypi. It is noted that in

8 cases there was evidence of hyperesthetic rhinitis. Four patients had pansinusitis of many years' duration.

This is a total of 16 cases in which there was or was not improvement out of a total of 29 cases of disease not charted as cured. In 2 cases there was evidence of atrophic rhinitis (cases 1 and 7). Only in cases 20 and 27 was there evidence of penicillin-sensitive organisms, and their lack of response has been explained.

GENERAL IMPRESSIONS

In no case was there any deleterious result from the use of penicillin. A comparison of the number of irrigations and/or the length of time required for cure within the various categories indicates an improvement over older technics. In cases of penicillin-sensitive infections improvement was dramatic. In cases of acute and subacute disease with no bacterial growth on culture the treatment period seemed shorter. Concomitant hyperesthetic rhinitis and the presence of polyps offered the poorest prognosis. These cases showed frequent negative cultures, so that the occasional positive culture, even when penicillin sensitive, was felt to be a contaminant or incidental finding inconsequential to the prognosis. No adequate explanation for sterile cultures in cases of acute disease has been forthcoming.

It is felt that hospitalization of patients with chronic sinus disease manifesting hyperesthetic rhinitis or polyposis for surgical or medical treatment which might be prolonged is contraindicated in the army. Patients 3 and 5 were given surgical treatment and promptly received certificates of disability discharge. Patients 9, 10, 16 and 27 showed psychoneurotic tendencies.

CONCLUSIONS

1. Sinuses affected with penicillin-sensitive organisms respond dramatically to treatment with penicillin in concentrations of 500 units per cubic centimeter, whether the disease is acute or chronic.

2. Hyperesthetic rhinitis occurring with sinus disease gives a poor prognosis for relief.

3. Hyperplastic disease and polypi accompanying sinus disease affect the prognosis adversely.

4. No conclusions could be drawn from numerous other observations, but the empiric use of penicillin, 500 units to the cubic centimeter, as an instillation, after a sinus has been washed, has proved harmless.

5. It is believed that results have been better with penicillin instillations than with any routine previously used.

AUDITORY ACUITY OF ARTILLERYMEN AND OF RIFLE COACHES

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A MAJOR portion of the ability to hear high tones which is lost immediately after exposure to gunfire is said to be recovered within twenty-four to forty-eight hours. However, with repeated acoustic insult, recovery may become progressively impaired, and a significant degree of deafness may result. This study was undertaken to determine the extent of hearing loss of artillerymen and of rifle coaches. Since premilitary audiograms of these men were not available, hospital corpsmen who reported no specific history of exposure to gunfire were used as controls.

METHOD

A number of audiograms were obtained of 130 artillerymen, 23 rifle coaches and 38 hospital corpsmen at Camp Lejeune, N. C. Before audiometry all ears were examined otoscopically and irrigated if excessive cerumen was present. All men with evidence of any acute disease of the upper respiratory tract were excluded from this study. A questionnaire relevant to the origin of auditory disturbance was obtained. This included the subject's clinical history, age, length of service and extent of preservice occupational exposure to noise.

Two Maico D5 audiometers, calibrated for intensity and frequency, were used for testing. All audiograms were made in a sound-insulated laboratory van or in a relatively quiet room. At least two audiograms were taken of all rifle coaches and of more than one half of the hospital corpsmen and artillerymen.

RESULTS AND COMMENT

Mean audiograms of hospital corpsmen, artillerymen and rifle coaches are presented in chart 1 and in table 1. Comparison of the mean audiograms of hospital corpsmen and artillerymen indicated that the latter lost a significantly greater amount of their ability to hear high tones. Rifle coaches, when compared to hospital corpsmen, showed significantly greater loss of hearing at all frequencies. The hospital corps group presented its greatest deviation below the audiometric zero line at 2,896 cycles per second (18.5 decibels). However, the greatest

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From the Medical Field Research Laboratory, Camp Lejeune, N. C.

The opinions and assertions contained in this report are the private ones of the writer and are not to be construed as official or as reflecting the views of the Navy Department or the Naval service at large.

decrement in hearing in rifle coaches and artillerymen occurred at 4,096 cycles per second (55 decibels, rifle coaches; 29 decibels, artillerymen).

Mean thresholds of left and right ears were essentially similar in each group. A few exceptions were noted. Right ears of rifle coaches showed greater loss of hearing at 5,792, 8,192 and 11,584 cycles per

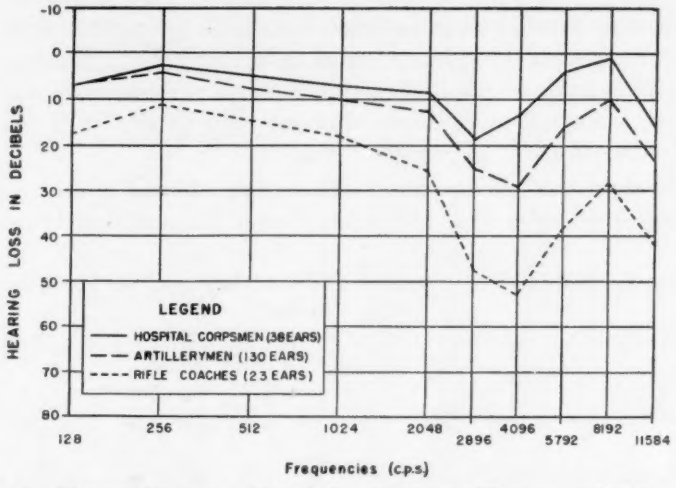

Chart 1.—Mean audiograms of hospital corpsmen, artillerymen and rifle coaches.

TABLE 1.—*Mean Audiograms of Hospital Corpsmen, Artillerymen and Rifle Coaches*

A. Left Ears

Group	No. of Ears	Frequencies (Cycles per Second) 128	256	512	1,024	2,048	2,896	4,096	5,792	8,192	11,584
		Decibels									
Hospital corps...	38	7.6	2.1	4.5	6.7	8.6	18.5	13.4	3.5	0.2	15.0
Artillery.....	130	7.0	3.5	7.2	9.6	**12.6***	**25.3**	**23.8**	**16.2**	**10.4**	**23.8**
Rifle coaches.....	23	**17.2**	**11.3**	**14.6**	**18.6**	**25.7**	**47.5**	**53.3**	**36.5**	**28.9**	**41.8**

B. Right Ears

Group	No. of Ears	Frequencies (Cycles per Second) 128	256	512	1,024	2,048	2,896	4,096	5,792	8,192	11,584
		Decibels									
Hospital corps...	38	8.1	1.7	4.0	6.6	8.2	17.4	15.4	4.1	1.2	14.5
Artillery.....	130	7.9	3.9	7.9	10.1	12.0	22.2	**26.2**	**17.3**	**12.0**	**25.3**
Rifle coaches.....	23	**16.9**	**10.5**	**14.1**	**17.1**	**26.5**	**49.7**	**54.9**	**42.0**	**36.5**	**44.6**

* Figures in bold face indicate statistically significant difference from mean threshold of hospital corpsmen; $p < 0.01$.

second (3 to 7.5 decibels). These differences are probably not significant.

Median audiograms for the different groups are indicated in table 2. At the higher frequencies median thresholds of hospital corpsmen and artillerymen are somewhat lower than the mean thresholds. The reverse is true in rifle coaches.

The artillery group reported no exposure to gunfire (75 mm., 155 mm.) for at least one week before testing. Unfortunately, the rifle coaches were exposed to rifle fire (M1) for several hours from three hours to ten days prior to testing. This may account, in part, for the greater auditory decrement observed in the latter group. However, the 3 coaches who had no exposure to gunfire for two to ten days before testing showed mean auditory thresholds for right and left ears which were greater than the means of the entire group. Reference has already been made to the finding that a major portion of the ability to hear high tones lost immediately after exposure to gunfire is recovered within twenty-four to forty-eight hours.[1]

Both right and left ears of all rifle coaches showed threshold curves which deviated more than 15 decibels below the audiometric zero line

TABLE 2.—*Median Audiograms of Hospital Corpsmen, Artillerymen and Rifle Coaches*

A. Left Ears

Group	No. of Ears	Frequencies (Cycles per Second) 128	256	512	1,024	2,048	2,896	4,096	5,792	8,192	11,584
		Decibels									
Hospital corps...	38	7	0	5	8	8	20	10	0	—3	10
Artillery.....	130	7.5	5	5	10	10	22.5	25	10	5	18
Rifle coaches.....	23	15	8	12	15	20	47	55	42	33	53

B. Right Ears

Group	No. of Ears	Frequencies (Cycles per Second) 128	256	512	1,024	2,048	2,896	4,096	5,792	8,192	11,584
		Decibels									
Hospital corps...	38	6	0	5	5	10	15	10	—1.5	—5	10
Artillery.....	130	7.5	2	7	10	10	20	20	10	5	20
Rifle coaches.....	23	17	10	11	15	22	42	53	47	35	57

at one or more of the frequencies tested. This may be compared to 86 per cent of right ears and 88 per cent of left ears of those in the artillery group and 63 per cent of right ears and 68 per cent of left ears of those in the hospital corps group. The percentage of ears showing hearing losses greater than 15 decibels increased in all groups at most of the higher frequencies. This increase was greater in rifle coaches and artillerymen than in hospital corpsmen (chart 2).

Mean and median ages, length of service, extent of preservice occupational exposure to noise and clinical findings are presented in table 3. (The values for hospital corpsmen include only 28 of the 38 men who were tested audiometrically. Mean audiograms of these 28 men are similar to the means of the entire group.) Examination of

1. Ogden, F. W.: Effect of Gunfire Noise upon Auditory Acuity for Pure Tones, Project 315, Report 7, Randolph Field, Texas, School of Aviation Medicine, Sept. 30, 1944.

ears did not indicate any appreciable differences between the three groups. Only a few cases of scarring of the tympanic membrane were found. Twenty-six per cent of both artillerymen and rifle coaches reported occupational exposure to noise in civilian life. Only 7 per cent of hospital corpsmen reported similar exposure. However, interpretation of what constitutes occupational exposure to noise may vary considerably in different subjects and, consequently, reliability

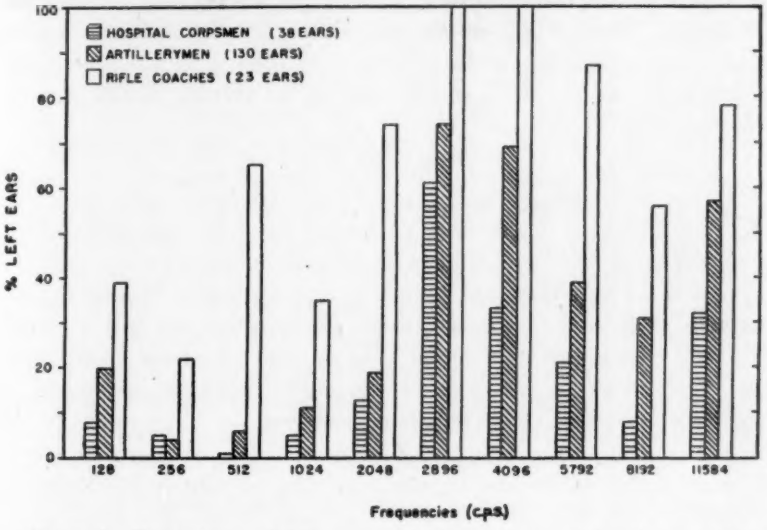

Chart 2.—Percentage of left ears showing a loss of hearing greater than 15 decibels.

TABLE 3.—*Results of Questionnaire*

Group and Number	Mean Age	Median Age	Length of Service, Yr.	Civilian Occupational Exposure to Noise		Scarring of Tympanic Membrane		Use of Cotton During Firing	
				% Yes	% No	% Yes	% No	% Yes	% No
Hospital corpsmen (28)....	22.0	20.0	1.4	7	93	5	93	..	..
Artillerymen (130).....	23.3	23.0	3.4	26	73	2	97	84	11
Rifle coaches (23).....	25.6	24.0	3.4	26	70	2	92	65	22

of the answers to this question is dubious. Furthermore, some men who reported preservice occupational exposure to noise did not show greater losses of hearing than men without occupational exposure.

The mean length of service for the artillery group was 3.4 years (range, 1.5 to 8 years). Mean audiograms of artillerymen with 1.5 to 3.4 years of service were not significantly different from those of men with 3.5 to 8 years of service. However, when rifle coaches were classified on the basis of length of service (mean, 3.4 years), the few

men with 3 or more years of coaching experience showed a somewhat greater decrement in hearing than men with less than 3 years of experience. The mean difference was 9 decibels at frequencies of 2,896 to 11,584 cycles per second. This difference is apparently not a function of age.

Eighty-four per cent of artillerymen and 65 per cent of rifle coaches reported the use of cotton during exposure to gunfire. Occasional use of cotton was reported by 4 per cent of the former and 13 per cent of the latter. There were no clearcut differences in auditory acuity between those who used cotton and the few men who did not. The latter group is small, and it is not possible to ascribe significance to this finding.

SUMMARY

Thresholds of auditory acuity were obtained for 130 artillerymen and 23 rifle coaches. These were compared with the thresholds of 38 hospital corpsmen who had no specific history of exposure to gunfire.

Loss in auditory acuity was significantly greater in rifle coaches and artillerymen than in hospital corpsmen. This decreased acuity resulted even though cotton was said to be used routinely by most of the men during exposure to gunfire. In all groups the greatest percentage of hearing losses occurred at the higher frequencies.

The following men assisted in conducting this survey: A. H. Masse, PhM 2/c, M. R. McKellar, PhM 3/c, D. D. Hendley, PhM 3/c and A. T. Kornfield, HA 1/c, U. S. N. R.

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GRADENIGO'S SYNDROME

Review of the Literature Since 1926 and Report of a Case Complicated by Frontal Sinusitis

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GRADENIGO'S syndrome affords the otologist one of the few dramatic episodes in otologic practice and often causes him no little anxiety because of what it may portend. The Italian author Gradenigo was the first to establish as a clinical entity the syndrome which bears his name. Isolated paralysis of the external rectus muscle complicating acute suppuration in the temporal bone had been reported in the literature a number of times prior to his presentation of this syndrome in 1904. To acute suppurative otitis media and paresis or paralysis of the abducens nerve of the same side he added the distinctive feature of temporoparietal pain of an unusually severe and persistent type and concluded that this formidable trinity constitutes a definite symptom complex.

INCIDENCE

This syndrome is relatively rare, but it occurs frequently enough to warrant inclusion of the subject in textbooks of otology and ophthalmology. It is seldom encountered by the individual otologist, who at most may observe but a few cases in the course of his practice. In 1907 Gradenigo collected 57 cases published in the literature up to that time and added 8. Three years later Perkins increased the number to 95, and in 1921 Vogel extended it to 129. Sears, in 1926, in a comprehensive presentation of the subject, reported a total of 172 recorded cases. In my extensive search of the literature which has been published since that time, I have been able to increase the number of cases by 226 (table). With these, the case herein reported brings the total number recorded, therefore, to 399 in the four decades since the syndrome gained recognition as a distinct clinical entity.

In Gradenigo's series of 65 cases, the syndrome occurred in men in 67 per cent of the 55 cases in which the sex was stated; the infection occurred on the right side in 57 per cent of the 49 cases in which the side of the head was mentioned. In 50 of the cases in this series the age incidence was 1 to 10 in 12 cases, 11 to 20 in 10 cases, 21 to 30 in 12 cases, 31 to 40 in 9 cases, 41 to 50 in 5 cases, 51 to 60 in 0 cases, 61 to

Read at the meeting of the Southern Section of the American Laryngological, Rhinological and Otological Society, Inc., Richmond, Va., on Jan. 7, 1946.

Summary of Reported Cases of Gradenigo's Syndrome

Author	Cases	Sex	Age, Yr.	Side	Outcome
Adam	1	M	11		
Adelstein	2	M	3	.....	Recovery
		F	11	Right	Recovery
Albernaz	1				
Amyot and Brahy	1	M	43	Right	Recovery
Anderson	1	F	12	Left	Death
Aráuz and González Avila	1	F	27	Left	Recovery
Aráuz and Tato	5	M	20		
		M	10	Right	Recovery
		M	17	.....	Recovery
		M	12	Right	Recovery
		M	5	.....	Death
Archer	2	M	43	Left	Recovery
		F	38	Right	Recovery
Baldenweck and de Prades	1	F	47		
Ballin	4	F	5½	Right	Recovery
		M	9	Right	Recovery
		F	11	Right	Recovery
		M	5	Right	Recovery
Barker	1	F	35	Right	Recovery
Barnes and Gimblett	1	M	16		
Belinoff and Balan	25				
Bernstein	1	M	10		
Bertein	1	M	31	Left	Recovery
Bigler	1	F	12		
Boonacker	7	F	45		
		F	28		
		M	19		
		F	45		
		F	46		
		M	9		
		M	18		
Boot	3	..	..	.....	Recovery
Bourgeois	1	M	..	Left	Recovery
C. J. Brown	1	M	20	Left	Recovery
L. G. Brown	1	M	24		
Bulson	9	M	6	Right	Recovery
		M	5	Left	Death
Burger	3	F	5	Right	Recovery
		F	10	Left	Recovery
		F	32	Right	Death
Cheney	1	F	60	Left	Recovery
Citelli	6	F	12	Right	Recovery
		F	34	Left	Recovery
		F	23	Right	Recovery
		F	19	Right	Recovery
		M	50	Right	Recovery
		M	36	Right	Recovery
Coates, Ersner and Myers	2	M	39	Right	Recovery
		M	8	Right	Recovery
Cottle	1	..	..	.....	Death
Crow	1	M	10		
Das	1	M	14	.....	Recovery
Dintenfass	1	F	6	Left	Recovery
Epstein	1	M	8		
Estcourt	6	F	31		
		M	44		
		M	22		
		F	17		
		M	31		
		M	21		
Felderman	1	M	16		
Fenton	1	M	7		
Festal and Girard	1	F	15½	Right	Recovery
Fine	1	M	9		
Forbes	1	M	9	Left	Recovery
Ford	3	..	..	.....	Recovery

Summary of Reported Cases of Gradenigo's Syndrome—Continued

Author	Cases	Sex	Age, Yr.	Side	Outcome
Franchini and Riccitelli	1	F	8	Left	Recovery
Frank	1	M	46	Right	Recovery
Frenckner	2	M	9		
		M	12		
Freund	1	M	9	Right	Recovery
Gaitung	5	F	12		
		F	8		
		F	6		
		M	7		
		?	43		
Games, Tato and Agra	1	F	18	Right	Recovery
Gardiner	1	F	9		
Giussani	1	F	30	Right	Recovery
Graham	1	M	13	Left	Recovery
Greenfield	1	F	6		
Hamilton and Kerr	1	F	19	Left	Recovery
Hutchison	1	M	39	Left	Recovery
Inferrera	2	M	45	Left	Death
		F	16	Left	Recovery
Jungert	9	F	16		
		F	39		
		M	12		
		F	7		
		F	24		
		F	54		
		F	21		
		M	7		
		M	13		
Kraus	4	F	18		
		M	40		
		M	47		
		F	25		
Lannois	1	M	5	Left	Death
Leech	4	F	3	Left	Recovery
		F	6	Left	Recovery
		M	14	Left	Recovery
		M	11	Left	Recovery
Leitch	1	M	70	Right	Recovery
Lemaitre and Aubin	2	F	9	Right	Recovery
		F	30	.....	Recovery
Loepp	8				
Lopez Andrade	2	M	26	Right	Recovery
		M	32	Left	Recovery
Lumsden	9				
McKinney	1	M	7	Right	Recovery
Malan	2	M	58	Left	Death
		M	4½	Left	Recovery
Mangabeira-Albernaz	2	M	25	Right	Death
		M	50	Right	Recovery
Martin	1	M	18	Left	Death
Merelli	1	M	63	Right	Recovery
Miller	1	M	8	Right	Recovery
Mitchell and Silverstein	1	F	12	Right	Death
Mounier-Kuhn	1	M	25	Right	Recovery
Oppikofer	1	F	48	Right	Death
Perrone	3	F	60	Right	Death
		M	60	Right	Recovery
		F	35	Left	Recovery
Phelps	1	M	6	Left	Recovery
del Piano and Bergara	1	F	7	Right	Recovery
Podestà	1	M	18	Right	Recovery
Profant	3	M	13	Right	Death
		M	12	Left	Death
		M	17	Right	Death
Renander	5	M	30		
		M	29		
		M	9		
		M	5		
		F	10		

Summary of Reported Cases of Gradenigo's Syndrome—Continued

Author	Cases	Sex	Age, Yr.	Side	Outcome
Roberts	1	M	16½	Left	Death
Russi	1	F	7	Left	Recovery
Schroeder	2	M	32	Left	Recovery
		F	20	Right	Recovery
Simpson	4	F	19	Right	Recovery
		F	32	Right	Recovery
		F	8	Right	Death
		F	22	Right	Recovery
Smith	1	F	28		
Stark	1	M	45	Right	Recovery
Sutton	1	F	44		
Tarasido	1	M	6	Right	Death
Tato	3	M	38	Right	Death
		M	17	Left	Recovery
		F	13	Right	Recovery
Tato and Beitia	1	F	20	Left	Recovery
Terracol, Millet, Sagols and Azémar	2	F	30	Right	Recovery
		F	..	Right	Recovery
Trivas and Tixier	1	M	15	Left	Recovery
Unterberger	1	M			
Uren	2	F	6		
		M	36		
van Voerthuysen	2	M	9		
		F	6		
Weise	1	M	50		
Whillis	1	M	22	Left	Recovery
Whitham	2	F	23	Right	Recovery
		M	34	Right	Recovery
Woodruff	1	F	12	Left	Recovery
Wright	1	M	16	.....	Recovery
Zange	15				
Zanni	1	M	9	Right	Recovery
Zanzucchi	1	F	41	Right	Recovery
Total	226				

70 in 1 case and above 70 years in 1 case, indicating the preponderance (68 per cent) of cases occurring in childhood and youth. It is of interest that analysis of the statistics available in the larger series, of 399 cases, confirms the early figures. The syndrome occurred in men in 57 per cent of the 156 cases in which the sex was stated; the right side was involved in 58 per cent of the 98 cases in which the side of the head was mentioned. In 160 of these cases the age incidence was 1 to 10 in 49 cases, 11 to 20 in 45 cases, 21 to 30 in 23 cases, 31 to 40 in 18 cases, 41 to 50 in 18 cases, 51 to 60 in 5 cases and 61 to 70 in 2 cases, 73 per cent occurring in the first three decades of life. These findings are in accord with those usually observed with abscess of the middle ear.

CLINICAL MANIFESTATIONS

The syndrome is characterized by three outstanding symptoms: suppuration of the middle ear, intense pain and loss of function of the external rectus muscle. The acute purulent otitis extends by one of several routes to the tip of the petrous portion of the temporal bone, causing localized meningitis at that point. As noted by Gradenigo,

indications of retention of pus in the tympanitic cavity arise because of insufficiency or complete lack of perforation, but perforation, when present, takes place usually in the anterior half of the drum. He observed that the otitis media is usually, though not always, acute and is commonly accompanied with mastoiditis.

Owing to inflammation of the gasserian ganglion, extremely severe pain, generally localized in the temporoparietal region and at times in the depth of the orbit of the same side, almost always accompanies the otitis. It varies in distribution according to the branches of the fifth nerve, which is seriously involved, with the ophthalmic division seeming to be the most vulnerable portion. Often agonizing, this pain may be continuous, or it may abate after discharge of purulent material from the external auditory canal only to recur after two or three weeks, as a precursor of the ocular complication. The movements of the eye on the side of the affected ear likewise may cause pain.

The most prominent symptom is paresis or paralysis of the abducens muscle, arising from involvement of the sixth nerve in the inflammatory process and its blockage thereby. In most instances it is present on the side of the involved ear, but it may be bilateral or contralateral. Infrequently, involvement of the third, fourth, seventh and eighth nerves has been noted.

Impaired action of the external rectus muscle seems to appear unexpectedly and causes the patient to complain of diplopia, because the two eyes have lost the power to coordinate properly. Could the paralysis be foreseen, a systematic examination of the function of the ocular muscles would probably enable the physician to recognize its gradual development, according to Gradenigo. As the paralysis becomes more pronounced, the diplopia likewise becomes more intense; it disappears gradually as the muscle regains normal function.

The appearance of this symptom is astonishingly late, usually from twenty to forty days after the onset of the infection in the ear. Gradenigo observed that in 37 cases in which the time of appearance could be definitely determined diplopia occurred in only 3 cases within from five to ten days after the onset of the otitis; in 20 cases it was present after from twenty to fifty days and in 10 cases after from forty-two to fifty days. He estimated that the paralysis as a rule is noted a month or a month and a half after the initial symptom of acute otitis media. In the case herein presented the paralysis was observed on the twenty-second day after the onset of the illness.

There are innumerable gradations between the paresis and the paralysis. Generally, recovery is complete, with gradual disappearance of the impairment. The period required for restoration of normal function varies from one to three months and rarely is as long as five months. In the case reported, this symptom began to recede in six weeks and

normal function was restored in another six weeks. Bourgeois was of the opinion that paralysis without neuralgia is of less serious import than neuralgia without paralysis, because paralysis of the sixth nerve attributable to petrositis may heal without direct intervention on the apex. He concluded that when it alone of the three danger signals is present simple congestion of the petrous portion of the temporal bone in the vicinity of the mastoid involvement is indicated.

Infrequently, nystagmus may precede or accompany the paralysis. Mild photophobia is occasionally present. Dizziness has been mentioned. Pupillary reaction is normal, and examination of the eyegrounds gives normal results. All ocular muscles except the abducens function normally. The acoustic region and the structures concerned with equilibrium are unaffected. In typical uncomplicated cases the temperature may remain normal throughout the course of the condition. If there is an elevation of temperature, pronounced fluctuations are absent; the range is usually between 100 and 102 F., with a rise to 104 and 105 F. only in the presence of a suppurative process extending inward to cause meningitis and extradural or brain abscess.

The clinical picture typically produced by acute purulent inflammation of the middle ear and the other cardinal symptoms of temporoparietal pain and paralysis of the abducens may in exceptional cases arise as a result of acute exacerbation of a chronic purulent inflammation of the middle ear, according to Gradenigo. In his opinion, in about 50 per cent of the cases of this syndrome symptoms related to involvement of the trigeminal and oculomotor nerves or the cerebral membranes may be present.

ETIOLOGIC AND PATHOLOGIC ASPECTS

In his extensive study Sears reviewed the observations and opinions expressed in the literature up to that time. He summarized Gradenigo's conclusions as follows: "The pathologicoanatomic process consists in a diffusion of the pus infection of the drum cavity to the pyramidal apex through the peritubal air cells and the carotid canal. The abducens is affected at the apex of the pyramid, close to its passage into the dura mater. We have to deal with a circumscribed osteitis at the pyramidal apex, and eventually with a corresponding pachymeningitis." This position provoked much discussion, but the consensus among many authors came to be that the anatomic position and relations of the sixth nerve at the apex of the petrous pyramid are largely responsible for its involvement as an otogenic complication.

Understanding of the anatomy of the region at the apex of the petrous portion of the temporal bone clarifies the probable mechanism incident to the paralysis of the external rectus muscle and the severe trigeminal neuralgia. Making its way along the base of the brain from the lower border of the pons, the abducens nerve enters the cavernous

sinus by piercing the dura mater below the posterior clinoid process; here it is in contact with the periosteum at the apex of the petrous pyramid of the temporal bone. Exposed for the distance of 1 inch (2.5 cm.) as it passes over the tip of the pyramid, it becomes particularly susceptible to infection at this point. As it approaches the cavernous sinus, it traverses Dorello's canal, a narrow fibroligamentous channel between the petrous apex and the posterior clinoid process of the sphenoid. An inflammatory process producing edema of the lining of this canal or extension of the suppurative process through the medium of a highly pneumatized petrous bone may subject the nerve to pressure, with subsequent paralysis of varying degree. After it passes through the cavernous sinus, it enters the orbit by way of the sphenoid fissure, where it lies between the two heads of the external rectus muscle and sends numerous small branches to the ocular surface of the muscle itself. Joining the abducens nerve are other nerve filaments, which take their origin from the carotid and the cavernous plexus, from Meckel's ganglion and from the ophthalmic nerve.

Thus it becomes apparent that the sixth nerve, because of its relatively close confinement in Dorello's canal and notch in the petrous bone, is perhaps the most vulnerable of the important structures about the petrous tip in the presence of even slight derangement. It may be subjected to involvement by localized meningitis, an extradural abscess or an extension of the thrombotic process having its origin in the lateral sinus and extending into the inferior petrosal sinus, which joins the cavernous sinus at the site of entry of the nerve into the wall of this sinus. Too, the fifth nerve with its gasserian ganglion, lying as it does in Meckel's dural cavity and resting in a depression on the anterosuperior surface of the petrous bone at its tip, can hardly escape involvement in any process in this region. The distribution of the acute pain characterizing the syndrome is explained by the intimate relation of this nerve with the tip.

It is noteworthy that the pneumatic type of mastoid is more likely to be associated with this symptom complex than the sclerosed type. This phenomenon may account for the frequency with which the syndrome occurs in children, for the mastoid is in childhood preeminently pneumatic in type. Profant was convinced that the type and degree of pneumatization of the petrous bone determine the route by which the inflammation reaches the apex. As noted by Coates, Ersner and Myers, a number of other authors shared his opinion that true petrositis, of which this syndrome is often a complication, can occur only in a pneumatized temporal bone.

The numerous modes of transmission from the ear to the nerves involved which are suggested in the literature include such routes as directly through cells from the tympanum to the apex; by way of the

labyrinth, through the oval or round window, or by necrosis of the promontory or prominence of the external semicircular canal and thence to cells about the labyrinth to the apex; by way of the internal auditory meatus or ductus and saccus endolymphaticus; by means of caries of the petrous bone indirectly through the various venous channels from the tympanum to the petrosal sinuses, the carotid plexuses and jugular bulb; by means of dehiscences, and by way of the lymphatic vessels. Perhaps Profant offered the most concise and comprehensive summary in his description of two routes of cells extending to the petrous tip—the "antrum-epitympanic route" and the "hypotympanic route"—determined on the basis that anatomically the cells can always be traced to one of these two routes, that embryologically they develop in this manner and that clinically the infection may extend from the hypotympanic space as well as from the antrum-epitympanic space. In the antrum-epitympanic route the cells extend from the antrum and epitympanic space above the cochlea and above and behind the superior semicircular canal, then, behind, above and in front of the internal auditory meatus and, finally, to the mass of cells under the tegmen of the anterior surface of the tip. In the hypotympanic route, the cells extend from the hypotympanic space below the cochlea, then, below the internal auditory meatus and, finally, to the mass of cells under the tegmen of the posterior surface of the tip.

Profant concluded that the complications of petrositis depend on the type and degree of the pneumatization, the virulence of the infection and the resistance of the patient. He was of the opinion that Gradenigo's syndrome is in the majority of cases a complication of petrositis, occurring otherwise as a complication of some other complication of involvement of the middle ear or the mastoid, such as sinus thrombosis, extradural abscess or abscess of the brain. Refuting the popular misunderstanding that Gradenigo's syndrome and involvement of the petrous tip are synonymous, Coates, Ersner and Myers emphasized that this syndrome is independent of petrositis but that petrositis may produce it.

The exciting organism may be any of those usually causing aural infections. As is to be expected in such extensive migrations or in widespread destruction of bone, the pneumococcus and the streptococcus are the most frequent agents. In the absence of characteristic pathologic lesions, however, the causation has remained debatable. Because of the high rate of recovery the opportunity for pathologic study of the abducens and trigeminus nerves is usually lacking and the results of the relatively few investigations at autopsy have proved inconclusive. Nevertheless, histopathologic studies indicate that suppuration of the apex of the petrous portion of the temporal bone occurs more frequently than was formerly suspected.

DIAGNOSIS

In cases of sudden paralysis of extraocular muscles, the ophthalmologist may be inclined to infer probable syphilitic origin or some toxic cause rather than be disposed to undertake a careful search for a definite underlying cause and a definite pathologic lesion. In Gradenigo's syndrome the ocular paralysis always affects the external rectus muscle only. Treatment should be left to the otologist, for on his success in treating the otitis media depends the recovery from the paralysis or paresis of the abducens muscle.

Roentgenologic study of the petrous pyramid has made possible the greatest progress in the study of this problem. Thorough roentgenologic examination, including a painstaking review of the sphenoid sinuses, and careful laboratory investigation are obviously of particular value as diagnostic aids.

Among the conditions to be considered in the differential diagnosis are septic thrombosis, thrombosis of the jugular bulb, epidural abscess, syphilitic (latent) meningitis and diffuse purulent or serous labyrinthitis.

TREATMENT

Recovery may take place spontaneously, or the syndrome may progress to generalized meningitis, with fatal termination. Although recovery has occurred in some cases without mastoidectomy and even without myringotomy, surgical intervention is as a rule indicated. Some patients recover after myringotomy, usually repeated, and a majority recover after a simple mastoidectomy with special attention to the cells about the antrum and the zygoma. Since the syndrome is a secondary manifestation, elimination of the original focus of infection by complete exenteration of the diseased tissue in the mastoid process and middle ear permits subsidence of the pathologic changes in the petrous bone and gradual resolution of the localized leptomeningitis, with eventual restoration of the abducens muscle to normal function. Rarely is the radical procedure of exploring the petrous tip indicated. Coates, Ersner and Myers observed that at least 80 per cent of the patients recover after simple mastoidectomy. The syndrome may develop weeks or months after a mastoidectomy, requiring reopening of the wound and further surgical measures.

In 1943, Barker reported a case of Gradenigo's syndrome complicated by pneumococcic meningitis, with recovery, in which treatment consisted of myringotomy, simple mastoidectomy and administration of penicillin and sulfadiazine in large doses. In my case, in which the syndrome was complicated by frontal sinusitis, sulfathiazole had an important therapeutic role. Other complications that may occasionally be encountered in the management of the syndrome, as mentioned by

Gradenigo, are mastoiditis, circumscribed and restricted extradural lesions of the sigmoid sinus and also circumscribed serous or diffuse purulent leptomeningitis, with fatal termination.

PROGNOSIS

The extradural location of the pathologic process explains the generally favorable course despite the distressing symptoms. Complete recovery usually occurs, but it may take place slowly, at times extremely slowly indeed. Occasionally, basilar meningitis or an abscess of the brain develops and proves fatal. Freund mentioned that the mortality is variously reported to be as low as 2 per cent and as high as 20 per cent, depending on the presence of other complications, with each case presenting an immediate prognosis potentially grave. The mortality in Gradenigo's series was 7 per cent, and in the larger series analyzed by Sears it was 18 per cent. In the 399 cases I reviewed, the rate was 18.6 per cent. The sulfonamide drugs and penicillin now offer promise of lower mortality.

REPORT OF CASE

M. J. D., a white boy aged 10, became ill on Dec. 4, 1944, with a cold and sore throat. The temperature at that time was 100 F., his parents reported. Two days later, when the temperature was 102 F. and the child complained of earache and severe temporoparietal pain on the right side, Dr. S. E. Driskell and I were called.

Examination revealed no bulging of the ear drum, and no fluid was present. Drops for the ear and ointment for the nose were prescribed, and 5 grains (0.32 Gm.) of acetylsalicylic acid was administered as needed to control the fever. Also, sulfathiazole was given in doses of 15 grains (0.97 Gm.) every three hours for the first twenty-four hours and 7½ grains (0.48 Gm.) every four hours for the next forty-eight hours. After several days, the symptoms abated and the temperature was reduced.

A few days later, just as the child was ready to return to school, the symptoms and the elevation of temperature recurred. The right ear drum was reddened, but no bulging or fluid level could be made out. The treatment previously described was resumed, and the symptoms again disappeared after several days. On this second occasion, however, the temporoparietal pain was more intense.

On the night of December 24, twenty days after the onset of the first symptoms, the patient again experienced a severe earache and temporoparietal pain on the right side. In addition, there was pain over the right frontal sinus. The parents proceeded with the treatment as given before. On the next day the boy complained of diplopia. As it was Christmas Day and acetylsalicylic acid kept the pain somewhat under control, neither Dr. Driskell nor I was notified until the following day. At that time bulging of the right ear drum, paralysis of the right external rectus muscle and severe temporoparietal and frontal pain were present.

A myringotomy was at once performed on the right ear drum, with resulting release of fluid under pressure. The earache and temporoparietal pain were thereby relieved, but the frontal pain on the right side persisted. Dr. Driskell again prescribed sulfathiazole therapy as outlined previously.

Roentgenologic examination of the skull, sinuses and mastoid was then ordered. The report of Dr. W. McL. Shaw, made on December 26, follows: "The right frontal sinus is about half the size of the left and is hazy, denoting sinusitis. The internal skull plate shows rather prominent convolutional markings."

Since cloudiness of the right frontal sinus was demonstrated roentgenologically, the sinus was opened and aspirated, with relief of the frontal pain. At the end of two weeks the purulent otitis had subsided, but pain in the temporoparietal region continued to recur intermittently. The sulfathiazole therapy was therefore continued until Jan. 15, 1945, when all symptoms except paralysis of the abducens muscle had disappeared.

On February 5, about six weeks after its first appearance, the paralysis of the external rectus muscle began to recede and on March 18 had completely disappeared. By this time the boy had regained his normal weight and, after an illness of approximately three and a half months, was ready to return to school.

COMMENT

In this case the characteristic feature of Gradenigo's syndrome were present, and, in addition, there was the complication of frontal sinusitis. The occurrence of the paralysis of the external rectus muscle of the right eye with diplopia on the twenty-second day after the onset of otitis media, and the presence concomitantly of severe temporoparietal pain on the same side were as typical as the complete disappearance of the paralysis twelve weeks later. It would appear that the sulfathiazole therapy employed was instrumental not only in saving the patient's life but also in obviating an extensive mastoid operation.

SUMMARY

The three striking characteristics of Gradenigo's syndrome are acute suppurative otitis media with or without mastoiditis; isolated paralysis of the abducens muscle, with homonymous diplopia, and severe pain in the frontal, temporal and parietal regions of the same side corresponding to the distribution of the trigeminal nerve rather than in the postauricular region, common to mastoiditis.

This syndrome occurs most frequently in children and young adults.

The right side of the head is somewhat more often affected than the left side.

The tympanum may or may not be perforated.

The paresis or paralysis of the external rectus muscle is a late manifestation, usually occurring from three to six weeks after the onset of the otitis. The accompanying diplopia gradually disappears as the muscle slowly regains normal function, complete restoration not infrequently requiring several months.

Occasionally diffuse meningitis develops, with fatal results. In view of the nature and severity of the symptoms, the mortality of approximately 18 per cent is not so high as might be expected.

Surgical intervention, usually a simple mastoidectomy, is most frequently indicated.

The advent of the sulfonamide drugs and penicillin should reduce the mortality and perhaps make surgical measures necessary less often.

A case is reported in which the syndrome was complicated by frontal sinusitis. Sulfathiazole therapy may have made mastoidectomy unnecessary in this case.

A careful review of the literature shows that 399 cases, including the 1 presented, have been reported in the forty years since Gradenigo gained recognition for the syndrome. An analysis of these cases is presented.

Buckman Building.

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DISEASES AND DEFECTS IN AIRCREW TRAINEES

VII. Ear, Nose, Throat and Oral Cavity

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THE following material is a report of diseases and defects of the ear, nose, throat and oral cavity in 344,134 applicants for pilot, navigator and bombardier training, found on examination at Army Air Force classification centers and Army Air Force basic training centers.

Previous physical examinations for aircrew training had been made on these men at other Army medical facilities (armed force induction center, Army Air Force bases and similar centers). Consequently, the diseases and defects found at this examination developed subsequent to the previous examinations, were overlooked or had not been considered severe enough for disqualification at the original examination.

Owing to the selectivity of this group, the incidence of diseases and defects found do not represent those of similar diseases and defects in a cross section of the general male population between the ages of 18 and 26 (age limits for aircrew training).

Because of the large number of examinations, however, it does give a base line, so to speak, of the frequency of defects and diseases of the ear, nose, throat and oral cavity to expect after a preliminary physical examination for aircrew training has been made.

MEDICAL EXAMINERS AND EXAMINEES

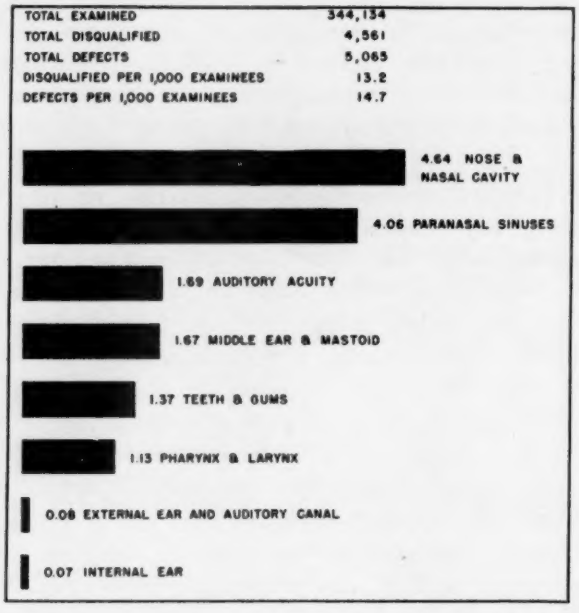
The medical examiners were well qualified physicians, representing a cross section of the medical profession from the country as a whole. A number were selected because of their special qualifications and interest in this type of duty.

The examinees were from all sections of the country and all types of communities. They had entered the aircrew training program from three main sources: from active duty with the various branches of the service; from civilian life, as aircrew enlisted reservists, and from the recruit reception centers, where, as new selectees, they volunteered for aircrew training.

From the Office of the Surgeon Headquarters Army Air Force Training Command.

EXAMINATION

The same type of physical examination was given each man: history, inspection of the ears, nose, throat and oral cavity and a whispered voice test as outlined in AR 40-110—audible whispered voice at 20 feet (6 meters). Roentgenograms of the mastoid or paranasal sinuses, audiograms or other special tests were made only when they were indicated in the opinion of the medical examiner.


TOTAL EXAMINED 344,134
TOTAL DISQUALIFIED 4,561
TOTAL DEFECTS 5,065
DISQUALIFIED PER 1,000 EXAMINEES 13.2
DEFECTS PER 1,000 EXAMINEES 14.7
4.64 NOSE & NASAL CAVITY
4.06 PARANASAL SINUSES
1.69 AUDITORY ACUITY
1.67 MIDDLE EAR & MASTOID
1.37 TEETH & GUMS
1.13 PHARYNX & LARYNX
0.08 EXTERNAL EAR AND AUDITORY CANAL
0.07 INTERNAL EAR

Distribution of physical defects (ear, nose, throat and oral cavity) in aircrew trainees.

RESULTS

The chart shows the relative frequency of the different types of diseases and defects found per thousand examinees. Those of greater incidence or interest are discussed in more detail.

In the 344,134 examinees, five thousand and sixty-five diseases and defects of the ear, nose, throat and oral cavity were found (14.7 defects per thousand examinees). Four thousand, five hundred and sixty-one men were disqualified (13.2 per thousand examinees), a ratio of 1.1 defects per man disqualified.

EXTERNAL EAR AND AUDITORY CANAL

A certain number of inflammations of the external auditory canal tend to have intermittent acute exacerbations. Some men disqualified

for this reason may have had quiescent infections at the time of the previous examination which were overlooked or considered negligible. External otitis may be aggravated by headphones and is sometimes difficult to cure. It may cause considerable discomfort as well as interference with hearing in an acute phase; if future trouble seemed probable the men were disqualified.

TABLE 1.—*Diseases and Defects of the External Ear and Auditory Canal*
(Incidence 0.08 per Thousand Examinees)

Disease or Defect	No. of Cases
Otitis externa	19
Injuries of auditory canal	1
Atresia of auditory canal	5
Other diseases and defects	4
Total	29

TABLE 2.—*Diseases and Defects of the Tympanic Cavity Membrane and Mastoid Air Cells*
(Incidence 1.67 per Thousand Examinees)

Disease or Defect	No. of Cases
Otitis media, acute	37
Otitis media, chronic catarrhal	14
Otitis media, chronic suppurative with perforated tympanic membrane	134
Otitis media, nonsuppurative with perforated tympanic membrane	112
Otosclerosis	2
Otitis media, repeated attacks, tympanic membrane intact	9
Tympanic membrane, retracted immobile	76
Tympanic membrane, manometric cicatrix and/or membrane	26
Tympanic membrane, traumatic rupture	45
Aero-otitis media	4
Tympanic membrane, other diseases and defects	43
Tympanic cavity, other diseases of	22
Eustachian tubes, nonpatent	8
Eustachian tube, other diseases or defects	1
Mastoid air cells, congenital defects	2
Mastoiditis, acute	11
Mastoiditis, chronic	14
Mastoidectomy, simple, less than 1 year	13
Mastoidectomy, radical	2
Mastoid air cells, other diseases and defects of	1
Total	576

Individual judgment as to how much partial atresia may interfere with function probably affected the low incidence reported.

TYMPANIC CAVITY AND MEMBRANE AND MASTOID AIR CELLS

The most frequent disease in this group was chronic suppurative otitis media, with perforated tympanic membrane. Previous oversight must account for the majority of the cases. In screening examinations small perforations are easily missed, particularly if there is no drainage at the time of the examination. In some instances, applicants for

aircrew training concealed a history of otorrhea even if they knew about it. Nonsuppurative otitis media with perforated tympanic membrane was the second most frequent cause for disqualification. The same comments apply to men with this condition as to those with suppuration.

There were 76 cases of retracted immobile tympanic membrane. In these cases aero-otitis media or defects in hearing are prone to develop. Individual interpretation varies concerning the degree of retraction or how much it interferes with function.

There were 45 men disqualified because of traumatic rupture of the tympanic membrane. When the age group, the number of men and the length of time since their previous examination are considered, swimming, boxing and athletic activities could easily account for these. Such persons were usually temporarily disqualified, to be qualified later if healing took place without impaired function of the ear.

TABLE 3.—*Diseases and Defects of the Internal Ear*
(Incidence 0.07 per Thousand Examinees)

Disease or Defect	No. of Cases
Labyrinthitis, chronic	2
Internal ear, other diseases or defects of	22
Total	24

In 37 cases, acute otitis media occurred after the original examination. The men were temporarily disqualified until six weeks after recovery if function was in no way affected. The low incidence of aero-otitis is due to the fact that few of these men had flown recently at the time of the examination.

Only 2 cases of otosclerosis were reported, but since over 500 men were disqualified because of impaired hearing (see following section) it is probable that some of the disqualifications were due to otosclerosis. Forty-three "other diseases and defects" of the tympanic membrane and twenty-two of the tympanic cavity were more than would be expected when the detailed classification used is considered.

In 11 cases, acute mastoiditis resulted from infections after previous examinations. In the 14 cases of chronic mastoiditis the condition probably was associated with chronic otitis media, mentioned previously.

INTERNAL EAR

Although chronic infection of the middle ear is the common predisposing factor of labyrinthitis, only 2 cases of labyrinthitis were reported in over 500 cases of chronic disease of the middle ear; the condition in these may have been quiescent at the time of the previous examination.

The twenty-two other diseases and defects of the internal ear probably represented a vague group with symptoms of tinnitus, vertigo, defective hearing or disturbance of equilibration that defied diagnosis in the time allotted.

AUDITORY ACUITY

Three hundred and fourteen cases of a mixed type of deafness were found as compared with 147 of deafness of the conductive type and 114 of deafness of the perceptive type. There were 53 more cases of the mixed type of deafness than of the conductive and the perceptive type combined.

TABLE 4.—*Disturbances of Auditory Acuity*
(Incidence 1.69 per Thousand Examinees)

Decreased Auditory Acuity	No. of Cases
Conduction type	147
Perception type, high tones	105
Perception type, low tones	9
Mixed type	314
Relaxed standards W. D. Cir. 176, 1943	6
Total	581

TABLE 5.—*Diseases and Defects of the Nose and Nasal Cavity*
(Incidence 4.64 per Thousand Examinees)

Disease or Defect	No. of Cases
Congenital defects	1
Chronic rhinitis	8
Atrophic rhinitis	40
Hay fever or substantiated history of	152
Allergic rhinitis, other types	298
Chemical rhinitis	1
Vasomotor rhinitis	20
Nasal obstruction (deviated septum)	579
Nasal obstruction (hypertrophied turbinate)	10
Nasal polyp	385
Polypoid degeneration of nasal mucous membrane	85
Perforated nasal septum	1
Anoxemia	2
Nose, other diseases and defects	9
Nasal cavity, other diseases or defects	7
Total	1,598

An accurate classification of distinct types of deafness is often difficult. Hearing tests alone are not sufficient, contrary to the classic teaching of loss of low tones for conduction deafness and high tones for perception deafness. Conduction deafness may be a loss of high tones or perception deafness a loss of low tones. A complete history must be taken and physical examination of the ear, nose and throat and air and bone hearing and tuning fork tests must be made before an accurate diagnosis can be arrived at.

NOSE AND NASAL CAVITY

The most frequent defect in this group was a deviated nasal septum. Since this condition was only temporarily disqualifying until corrected, if it was not associated with some other permanently disqualifying defect, the incidence here represents only that in the "combined" group. The true incidence of deviated nasal septum is therefore unknown. Individual judgment concerning the degree of malfunction due to a deviated septum varied widely between different examiners. Many examinees had had submucous resection prior to applying for aircrew training.

The second longest number of disqualifications in this group was for allergic rhinitis (450), of which 152 were for "hay fever." Larger numbers were undoubtedly disqualified during the previous examination.

The diagnosis of allergic rhinitis is easily missed, particularly when many applicants concealed a positive history and also if they applied during quiescent periods. Differentiating allergic rhinitis from hydrorrhea due to vasomotor neurosis in a limited time is difficult inasmuch as the clinical findings are similar and the history may be atypical or vague.

As a result of these factors, a number of men were qualified only to be disqualified later because of a recurrence of symptoms.

Three hundred and fifty-eight men were disqualified for nasal polyps and polypoid degeneration of the nasal mucous membrane. Some of these changes were probably minor and overlooked at the previous examination.

PARANASAL SINUSES

One thousand, three hundred and forty-four men were disqualified because of chronic sinusitis. Signs and symptoms of this disease fluctuate

TABLE 6.—*Diseases and Defects of the Paranasal Sinuses*
(Incidence 4.06 per Thousand Examinees)

Disease or Defect	No. of Cases
Sinusitis, acute	25
Sinusitis, chronic	1,344
Mucocele of sinus	9
Polyp of sinus	16
Aerosinusitis	1
Other diseases or defects	1
Total	1,396

considerably from time to time and also according to season, climate and geography. Symptoms vary greatly in different persons having the same clinical degree of disease. It is striking to see the pronounced subjective symptoms in some persons with few abnormal clinical signs and again to see so few subjective symptoms in others with pronounced

abnormal findings. In practically all cases, in conjunction with the clinical findings, roentgenograms were taken into consideration prior to disqualification.

PHARYNX AND LARYNX

The incidence of chronic and hypertrophic tonsillitis as in the cases of deviated nasal septum is abnormally low, since they represent the "combined" type of defects. Neither of these conditions was considered disqualifying when uncombined, since they were easily corrected.

The low incidence of other diseases reported is due to the fact that there are not many diseases and defects of this type in this age group.

TABLE 7.—*Diseases and Defects of the Pharynx and Larynx*
(Incidence 1.13 per Thousand Examinees)

Disease or Defect	No. of Cases
Injuries of pharynx	1
Tonsillitis, chronic	189
Tonsillitis, hypertrophic	192
Pharynx, other diseases or defects	3
Injuries of larynx	1
Larynx, other diseases or defects	4
Total	390

TABLE 8.—*Diseases and Defects of the Oral Cavity, Teeth and Gums*
(Incidence 1.37 per Thousand Examinees)

Disease or Defect	No. of Cases
Congenital defects of oral cavity	3
Stomatitis	1
Oral cavity, other diseases or defects	4
Salivary glands, other diseases or defects	1
Congenital defects of teeth and gums	5
Insufficient teeth to masticate Army rations	39
Class 1 teeth	290
Gingivitis	4
Edentulous upper and/or lower jaw	124
Total	471

ORAL CAVITY, TEETH AND GUMS

Many of the disqualifications for class I teeth and edentulous upper and/or lower jaws were the result of differences of judgment of the original dental examiner and a certain amount of confusion concerning the intent of directives current at that time.

COMMENT AND SUMMARY

Three hundred and forty-four thousand, one hundred and thirty-four men who had been given previous physical examinations and physically qualified for aircrew training (bombardiers, navigators and pilots) were examined and found to have 14.7 diseases and defects of the ear, nose,

throat and oral cavity per thousand examinees. Thirteen and two-tenths examinees per thousand were disqualified. Some men had more than one disease or defect, any one of which could have been disqualifying; others had several diseases or defects, all correctible but one. Some of these diseases and defects had been overlooked previously, but others represented a difference of opinion among medical examiners as to the degree of severity of the diseases or defects. A few acute diseases developed after the original examination.

The great majority of these men keenly desired to be qualified, and in many instances accurate histories were difficult to obtain, since the person was hesitant to disclose anything that would affect him adversely. A history of allergic rhinitis, especially, was likely to be concealed or denied.

The interpretation of clinical findings varied in some diseases, especially in chronic sinusitis, allergic rhinitis and possibly small nasal polyps. What would be acceptable to one examiner might not be to another. Roentgenograms gave considerable assistance in doubtful diagnoses, especially in chronic sinusitis, chronic mastoiditis and polyps or mucoceles of the paranasal sinuses.

TABLE 9.—*Comparison of Diseases and Defects of Selective Service Registrants with Aircrew Trainees*

Disease and Defect	Selectees, No. per 1,000 Disqualified	Aircrew, No. per 1,000 Disqualified
Defects of ear, nose, throat and oral cavity (over-all)	20.5	13.2
Defects of ears, over-all	16.0	3.5
Otitis media	10.3	0.6
Defects of nose, over-all	2.8	8.7
Vasomotor and allergic rhinitis	0.6	3.0
Chronic sinusitis	0.6	3.7

Different diagnoses for the same diseases or defects accounted for some of those classified under "other diseases and defects"; others were uncommon diseases, not listed in the detailed classification of diseases used by the examiners.

The great majority of the diseases and defects found were the ordinary ones, to be expected. Two thirds were of nasal origin, three diseases alone accounting for disqualifications of 2,264 men: 1,344 with chronic sinusitis, 450 with allergic rhinitis and 470 with nasal polyps or polypoid degeneration of the turbinates.

Aural diseases and defects composed the second largest group, with five hundred and eighty-one defects in hearing and five hundred and sixty-seven chronic infections of the middle ear.

Four hundred and nineteen dental diseases and defects (class I teeth or edentulous upper and/or lower jaws) accounted for the third largest

group of diseases and defects. This was the result of misinterpretation of regulation as well as of oversight and differences in opinion of the dental examiners.

A comparison of the disease and defects found on these examinations with those found on examination of 18 and 19 year old selective service registrants by Rowntree and colleagues [1] is interesting (see table 9).

While the over-all disqualification rate for defects and diseases of the ear, nose, throat and oral cavities is greater in the selectees, the incidences of the individual diseases and defects are quite different. This is due to the following causes: the selectees had not been examined previously, the standards of the examination were different and the requirements for the ear and nose in aircrew trainees are much more stringent.

Selective Service disqualified 0.3 men per thousand because of diseases and defects of the throat as compared with 1.01 men per thousand being disqualified for aircrew training. Chronic tonsillitis and hypertrophied tonsils represented the difference here, as discussed previously. Both types of examinees had about the same disqualification rates for the oral cavity—1.4 and 1.3 men per thousand.

When the conditions under which the original examinations were given and the limited time available are considered, there was a small percentage of error.

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1. Rowntree, L. G.; McGill, K. H., and Edwards, T. I.: Causes of Rejection and the Incidence of Defects Among 18 and 19 Year Old Selective Service Registrants, J. A. M. A. **123**:181-185 (Sept. 25) 1943.

Case Reports

OBSTRUCTION OF THE NASOPHARYNX SECONDARY TO CHOANAL POLYP OF ANTRAL ORIGIN

Report of Three Cases

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Medical Corps, Army of the United States

CHOANAL polyp of antral origin while not a rare condition occurs relatively infrequently. Three cases are reported, of which 2 were found in a military practice which included more than twenty-five thousand ear, nose and throat examinations over a period of three years. The third case was seen in civil practice just prior to my entrance into the service.

The development of this type of growth has been well described by Goldsmith[1]:

> The antral lining is but a continuation of the nasal mucosa; it is obvious that whenever the nasal mucosa becomes markedly inflamed, a similar process takes place in the antrum, and if the inflammation is severe persistent swelling of the mucous membrane at the ostium completely shuts off the antrum from the nose. In this manner, an acute rhinopharyngeal inflammation may initiate an acute inflammatory process in the antrum of Highmore. The air space of the antrum is thus greatly restricted and is partially filled with the usual products of the acute mucosal inflammation. In some places the enlargement of the mucosa is so great that by pressure alone it is pushed out through probably an accessory ostium into the nasal cavity, where it is a dependent piece of oedematous mucosa membrane—really a nasal polyp. When recession of the mucosa in the antrum takes place as the inflammation subsides, this protruded portion may not recede owing to its having become large, and we then have the beginning of what is termed a choanal polypus in the posterior nares.

The diagnosis of this condition is based on a history of severe chronic nasal obstruction, profuse purulent nasal discharge, usually unilateral, pain referred to the maxillary region, and at times an obstructed feeling in one or both ears with gradual impairment of hearing. There is usually a history of long continued nasal treatment without relief. Examination reveals a large polyp, most frequently single, which projects from the middle meatus, completely filling the nasal chamber and extending into the nasal pharynx. Posterior rhinoscopy reveals the large mass in the nasopharynx. It has been my practice to use digital palpation of the nasopharynx in any case of suspected nasal obstruction. With the palpating finger the mass is easily felt, and the diagnosis readily made. Roentgen examination of the sinuses will show evidence of chronic inflammation in the antrums,

1. Goldsmith, P. G.: Diagnosis and Treatment of Inflammation of the Maxillary Antrum, Canad. M. A. J. **23**:512-524, 1930.

and, on lateral views, a large globular mass extending into the nasopharynx. Pathologically, this growth resembles a nasal polyp and it is usually so diagnosed. It differs, however, from a nasal polyp in that it is firmer and contains a great amount of dense fibrous connective tissue, which may be undergoing myxomatous changes.

Adequate treatment requires removal of both the nasal and the antral portion of the polyp. The operative procedure consists of the Caldwell-Luc operation, at which time the mass in the antrum is removed and the pedicle of the tumor severed at the natural or accessory ostium. The pharyngeal portion of the tumor is removed through the mouth by elevating the palate and grasping the growth with a large tenaculum.

REPORT OF CASES

CASE 1.—This patient, a white man aged 24, was first seen in April 1941. At that time he gave a history of nasal obstruction for the previous two years. During this period he had been treated with nasal tampons, nose drops, etc., without relief. There was pain at intervals in the right maxilla and a profuse nasal discharge. At this time the hearing of the right ear was becoming slightly impaired. Examination revealed a large polyp, which completely filled the right nasal chamber and was easily visible at the nares. On shrinking the nose, the tumor could be visualized projecting from the middle meatus. In view of the complete obstruction to nasal respiration bilaterally, posterior mirror rhinoscopy was done, and a large gray polypoid mass was seen. Direct palpation confirmed the fact that this mass entirely filled the nasopharynx. On transillumination of the sinuses, the right antrum was completely opaque. Roentgen examination of the sinuses, which was done by Dr. W. E. Chamberlain, Temple University Hospital (fig. 1), revealed the right antrum to be completely opaque. On a lateral projection, a large mass could be seen in the nasopharynx, which could easily be traced from the right antrum.

On April 15 the patient was admitted to the Temple University Hospital, and a Caldwell-Luc operation was done on the right side. After the antrum had been exposed, a large polypoid mass was seen, which completely filled the sinus, and the neck of the mass could be seen projecting through the ostium of the sinus into the middle meatus. The growth was severed at the ostium of the sinus, and the diseased sinus mucosa was completely removed. A large tenaculum was then inserted into the nasopharynx, and the nasal and pharyngeal portion of the growth was extracted through the oral route (fig. 2).

The patient made an uneventful recovery and was discharged from the hospital in five days. To date there has been no recurrence, and the patient is free of symptoms.

Pathologic Report (Dr. F. W. Konzelman).—The specimen was of a cyst from the right antrum and the pharynx.

Gross Description: The specimen consisted of a piece of tissue 6.5 by 2.5 cm. One end for 3 cm. consisted of a cyst lining. The latter was opened and contained no fluid. The remaining part of the specimen consisted of myxomatous tissue.

Microscopic Description: The lining of the cyst consisted of tall columnar epithelium. The cavity contained a pink staining material and neutrophils. The tissue described as myxomatous was such under the microscope and contained several vessels. However this did not appear to be malignant.

Diagnosis: The diagnosis was of a cyst from the antrum showing a mild chronic inflammatory reaction.

CASE 2.—The patient, a flight officer aged 29, was admitted to an army station hospital on March 5, 1943, with the complaint of complete nasal obstruction bilaterally. This was troublesome while flying, especially on descent, at which time there was considerable pain in both ears due to obstruction of the

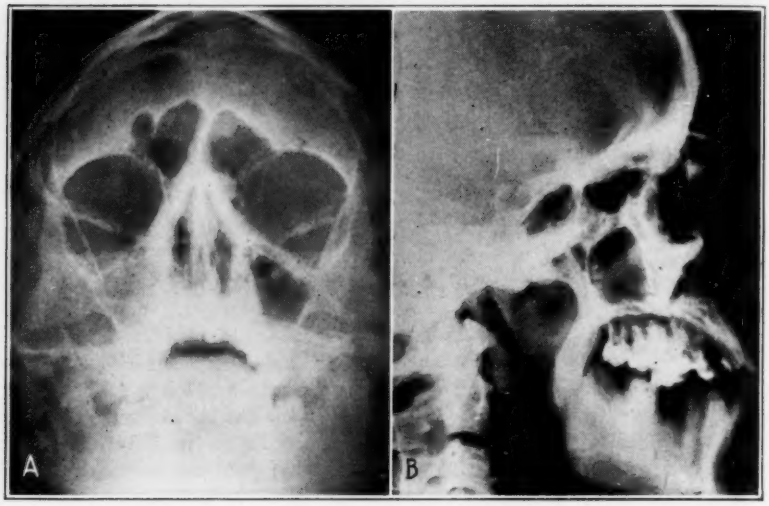

Fig. 1 (Case 1).—*A*, Posteroanterior roentgenogram of the paranasal sinuses showing opacity of the right antrum. *B*, Lateral projection showing large soft tissue mass in the nasopharynx which can be traced from the right antrum.

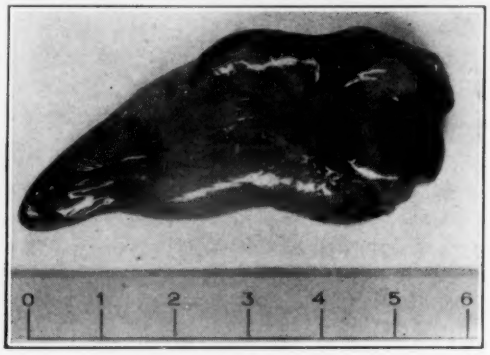

Fig. 2 (Case 1).—Photograph of specimen removed from the nasopharynx showing the large size of the tumor, which measured 6.5 by 2.5 cm.

eustachian tubes. These symptoms had become progressively worse during the previous four weeks.

Examination revealed a large solitary polyp which completely filled the left nasal chamber and which could readily be seen coming from the left middle meatus. On posterior rhinoscopy, a large gray polypoid mass was seen to be filling the nasopharynx bilaterally. This was confirmed by digital palpation.

Roentgen examination on March 5 by Captain L. A. Rice showed a marked diffuse cloudiness of the left maxillary sinus. In the lateral view, there was a sharply circumscribed shadow of soft tissue density extending from the antrum into the pharynx, where it enlarged as an ovoid mass measuring 2 by 2.5 cm. In the sphenoid view, this oval density could be seen in the midline of the pharynx (fig. 3).

On March 6 a left Caldwell-Luc operation was done. When the antrum was exposed, a large polypoid mass was seen completely filling the sinus cavity and projecting through the natural ostium into the nasal cavity. The polypoid tissue was completely severed in the region of the sinus ostium. When this phase of the

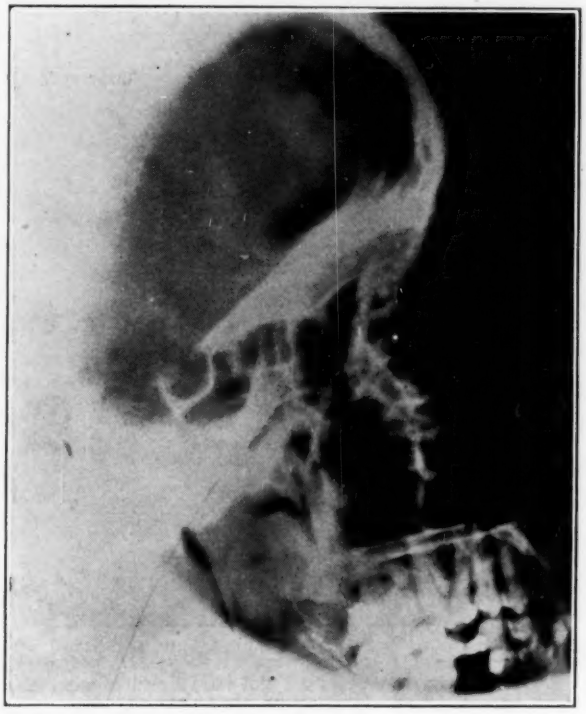

Fig. 3 (Case 2).—Lateral roentgenogram of the paranasal sinuses showing the large soft tissue mass in the nasopharynx. (Official photograph by United States Army Air Forces Photographic Section.)

operation was completed, a large tenaculum was used to grasp the nasopharyngeal mass through the oral route, and it was easily removed. The patient made an uneventful convalescence and was discharged from the hospital ten days later.

Pathologic Report (Lieutenant J. C. Reese).—Gross Description: The specimen consisted of six irregular nodular fragments of tissue which were grayish white and somewhat gelatinous in texture. On section, the cut surface was light gray and slightly gelatinous and was transversed by numerous fibrous septums.

Microscopic Description: The stroma was composed of loosely woven strands of fibrous connective tissue that were vascular and heavily infiltrated in many areas with red blood cells and with chronic inflammatory cells. A few portions

showed a pronounced degree of fibrosis within the stroma. The sections were covered on the outer surface by columnar epithelial cells, some of which showed cilia.

The diagnosis was of nasal polyp.

CASE 3.—This patient, a white private first class aged 20, complained of nasal obstruction for the previous four years. He suffered from repeated respiratory infections and numerous attacks of tonsillitis. He was admitted to an army station hospital on Aug. 13, 1943, for a tonsillectomy. During the routine examination a large yellow polypoid mass was noted extending from the right middle meatus. This was easily visualized and followed into the rhinopharynx. Posterior rhinoscopy and digital palpation confirmed the impression that this was a choanal polyp, probably of antral origin. There was considerable purulent drainage from

Fig. 4 (Case 3).—Lateral roentgenogram of the paranasal sinuses, following the injection of iodized poppyseed oil 40 per cent into the right antrum. A large soft tissue mass is visualized in the right antrum and nasopharynx. A few drops of lipiodol 40 per cent iodine were injected into the mass. (Official photograph, United States Army Air Forces Photographic Section.)

the right middle meatus. The right antrum was cloudy on transillumination. Roentgen examination was made on August 9 by Captain L. R. Rice:

"Roentgen examination of the sinuses showed increased cloudiness of both antrums with a small rounded density arising from the floor of the right maxillary sinus. In the lateral view arising from the floor of the antrum could be seen two soft rounded densities which had the appearance of pedunculated cysts. My impression was of bilateral maxillary sinusitis with pedunculated cysts of the right antrum.

"Roentgen examination of the left maxillary sinus into which iodized poppyseed oil had been injected showed a uniform filling of the sinus except at the base, at which there was a displacement of the opaque medium by an oval area

of rarefaction. In the lateral view, there could be seen extending posteriorly from this area of rarefaction a linear broken stream of this opaque medium extending into a soft shadow at the posterior pharynx. There was also a widening of iodized poppyseed oil 40 per cent in the cyst of the right antrum.

"My impression was of chronic right ethmoid sinusitis and of chronic bilateral maxillary sinusitis with polyp formations (fig. 4)."

On August 13 a Caldwell-Luc operation on the right side was done. The maxillary sinus was full of several large polypoid masses, one extending through the ostium of the maxillary sinus into the nasal cavity and then into the nasopharynx. The pharyngeal mass was globular, lobulated, firm and approximately 5 by 2.5 by 1.5 cm. The abnormal mucosa was removed from the antrum, and then a large tenaculum was inserted through the mouth into the rhinopharynx, and the tumor was grasped and removed.

Pathologic Report (Captain E. S. Ingraham).—"The specimen consisted of a large gelatinous polypoid mass and a number of pieces of thin gray membrane. The large polypoid structure measured 5 by 2.5 by 1.5 cm. and consisted of several irregular lobules all of which were composed of exceedingly edematous loose connective tissue enclosed by a thin white membrane. The membraneous tissue was in numerous irregular pieces which measured up to 3 cm. and some of these appeared to be collapsed polypi. Sections of the pieces of membrane showed respiratory mucosa covered by the usual pseudostratified, dilated columnar epithelium. There were edema and round cell infiltration of the submucosal connective tissue. A few submucosal glands were surrounded by a slight amount of round cell infiltration. A section of the polypoid mass showed it to be covered by respiratory epithelium enclosing loose edematous connective tissue in which there was hemorrhage and infiltration by lymphocytes and plasma cells.

"The diagnosis was of a nasal polyp."

The postoperative course was completely uneventful, and the patient was discharged for duty at the end of ten days.

SUMMARY AND CONCLUSIONS

Three cases of choanal polyp presented similar clinical and roentgenologic findings. These cases were encountered in a three year period during which over twenty-five thousand otorhinologic examinations were made. The history, clinical and roentgenologic findings are sufficiently characteristic so that no difficulty should be encountered in the diagnosis. The treatment of choice is the Caldwell-Luc operation and the removal of the pharyngeal mass through the oral route.

Clinical Notes; New Instruments and Technics

FATIGUE TEST AND ITS SIGNIFICANCE

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ONE WILL rarely find the evidence of fatigability of the auditory end organ in cases of simple catarrhal deafness, but it is a common phenomenon in many types of nerve deafness. It appears most prominent and pronounced in traumatic deafness of the war casualty type, the result of heavy concussions. It appears less pronounced in the deafness of aviators, in whom a true nerve deafness develops from both noise and pressure changes. In such cases the deafness, at least in the beginning, is mild and of the mixed type, and recovery is relatively prompt.

The test is simple: One takes an audiogram, getting threshold hearing values. Then pitches of either 1024 or 2048 double vibrations are selected to see if with these pitches the ear can be fatigued. The most deafened ear of the patient is exposed to a pitch loudness 25 decibles above his threshold. Three minutes is a good exposure time to take. After this period, one again records the hearing threshold for the pitch, and the difference between it and the original reading represents the fatigue.

The retestings at the same frequency over a period of one hour give an index of recovery, its speed and degree.

Rarely does one find a carry-over of tone memory to interfere with the test, but if this does occur it can be discovered and eliminated by use of the sharp cut-off switch.

The following cases are illustrative.

J. B., an artillery control officer, has been much exposed to the noise of heavy gunfire. Further than this, he has made many flights in open cockpit planes, as an artillery spotter. On his entrance into service there was no history of deafness. The deafness first came on when he was working with his battery and before he became an aerial spotter. He noticed a certain amount of recovery of hearing after each occasion of heavy exposure, provided there was an interval in which his ears could rest. Occasionally, the trauma would be repeated four or five days in succession. At no time was dizziness experienced. Recovery from the damage could never have been complete, because he became more and more deaf. He noted, what has been reported by others, that some of the men were little affected, others moderately and some greatly.

The obvious significance of this observation is that men showing deafness and auditory fatigue from gunfire should be transferred out of this type of service.

The second case is that of a highly intelligent, keen and sensitive aristocratic woman, who, while trying to conceal her deafness, has not ceased to continue an active social life, with many contacts where the hearing of language is apparently important. Strange to say, she does remarkably well when tested by metered speech, while showing great loss above 500 frequency in pitch-hearing testing. Here, then, is another case in which one cannot imply from an audiogram what speech hearing may be. It is a truly remarkable thing that, hearing the speech

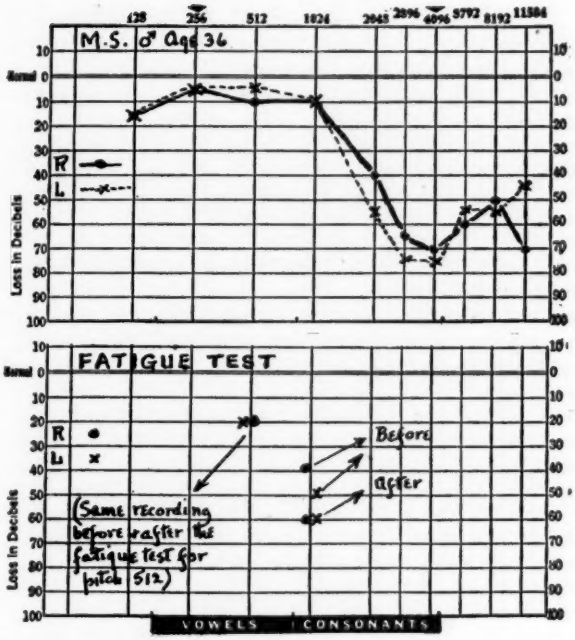

Chart 1.—Deafness (nerve type) from noise damage in an artillery officer. The chart shows the fatigue phenomenon.

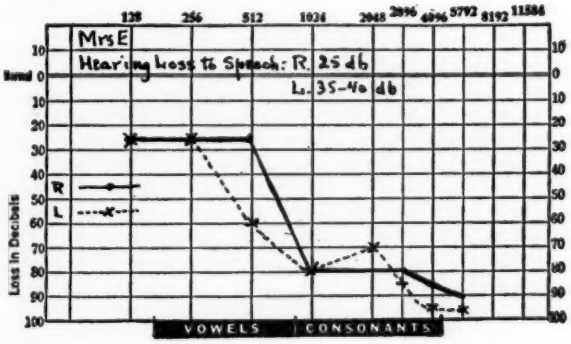

Chart 2.—Nerve deafness in an elderly woman. There is great loss to pitches above 500 cycles, and yet there is fair speech hearing. The chart exhibits fatigue after exposure to loud sounds.

frequencies only up to 500, she interprets speech so well. It will be recalled that the practical range for speech is between 300 and 3,000 cycles, with the most important part of the range lying at 1,000 to 2,000 frequencies. (The possibility of lip reading is excluded by the metered phonograph-audiometer test.)

Testings in this case confirm uncomplicated nerve deafness. The patient shows auditory fatigue of 10 decibels for pitch 1,000 in the right ear and of 15 decibels in the left ear. There is no tone memory. There is an enormous amount of strain in her successful efforts at synthesizing and "guessing" the few frequencies of the speech she hears into the true words spoken. The fatigue test confirms an added factor in the nerve strain of this woman.

It should be stated that the fatigue test is neither practical nor possible in the profoundly deaf, who have not enough of a hearing remnant to permit of their exposure to a fatiguing intensity.

Progress in Otolaryngology

PERORAL ENDOSCOPY

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AND
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ANESTHESIA IN PERORAL ENDOSCOPY

THE study and investigation of anesthesia during the past ten years has led to a better understanding of the physiology of respiration, the action of anesthetic agents and the improved methods of their administration. The field of peroral endoscopy therefore has benefited. The endoscopist employs all types of anesthesia and all methods of induction. It is not always easy to make an endoscopic examination of the air and food passages under local anesthesia, and the casual endoscopist frequently will choose general anesthesia. In a study of this subject, Whalen [1] found that routine methods following fixed rules do not make for good anesthesia. Individual cases call for specific types of preanesthetic preparation and a personalized type of anesthesia.

Of the preanesthetic agents commonly employed morphine, which is most widely used, is the best understood of all the narcotics. It is valuable whether the anesthesia is to be of a local or a general type. It is commonly combined with atropine or scopolamine, since this combination results in a synergistic effect that aids the physiologic action of both drugs. Whalen found that in practice the ideal situation is accomplished by the use of 25 parts of morphine sulfate to 1 of scopolamine. The dose commonly given for an adult is ¼ grain (15 mg.) morphine sulfate and 1/100 grain (0.6 mg.) scopolamine hydrobromide, this to be given one hour before administration of local anesthesia for the endoscopic procedure.

The barbiturates also are widely used as preanesthetic agents. They are hypnotic but not analgesic in their action, with the maximum effect appearing in about thirty minutes. In addition to their hypnotic action they are of definite value if cocaine is to be employed as the primary anesthetic, since they do much to protect against the convulsive reactions to cocaine and allied drugs.

It is often hazardous to use local anesthesia for endoscopic procedures in children. Frequently the procedures can be carried out without

1. Whalen, E. J.: Anesthesia in Peroral Endoscopy, Ann. Otol., Rhin. & Laryng. **53**:469 (Sept.) 1944.

anesthesia, general or local, if preliminary use is made of one of the short-acting barbiturates. Whalen found cocaine hydrochloride in 5 per cent solution a satisfactory local anesthetic for routine endoscopic procedures. Larocaine did not appear to produce adequate anesthesia. Sensitivity to tetracaine hydrochloride is common, and its use often is followed by constitutional reactions, some of them fatal.

Of the general anesthetic agents those of the inhalation group are the best understood. Ether given either by drop or by closed method is a safe anesthetic for the majority of patients, both young and old. Its administration can be continued throughout the endoscopic procedure. General anesthesia induced with the barbituric acid derivatives given by the intravenous route finds a wide field of application in peroral endoscopy. The disadvantages connected with barbiturates given intravenously are of a serious nature but can be anticipated and partly overcome. The tendency toward laryngospasm always is present, and the depression of the respiratory and circulatory system is sometimes profound and terrifying. Pentothal sodium is commonly employed as an intravenous anesthetic and has many advantages over evipal, which it has replaced. Its use is contraindicated in infants, children and the aged. The administration of morphine and atropine or scopolamine one hour before induction of anesthesia with pentothal sodium is essential, and the employment of a local anesthetic solution preliminary to its administration is of utmost importance to prevent laryngospasm. Whalen emphasizes the need of making adequate provision for the many unforeseen incidents that may occur during intravenous anesthesia.

While many laryngologic operations can be performed by indirect laryngoscopy, the ease with which suspension laryngoscopy can be employed makes indirect laryngoscopy hardly necessary. In the past Adams [2] and his associates employed ether as the anesthetic of choice. While this form of anesthesia usually was satisfactory, the methods involved certain drawbacks, for certain problems that are not encountered elsewhere in anesthesia are observed when one is operating on the larynx. The reflexes in the laryngeal region are particularly active and disappear only after deep surgical anesthesia has been accomplished. Muscles of the neck must be thoroughly relaxed to permit a clear visual field. The vocal cords must be relaxed and remain separated so that a lesion can be removed completely without undue trauma. Another factor of importance is the frequent use of electrocautery in laryngeal surgery, the danger of which is greatly increased when an explosive or inflammable anesthetic mixture is being employed.

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2. Adams, R. C.; New, G. B.; Lundy, J. S., and Seldon, T. H.: Intravenously Induced Anesthesia for Operations on the Larynx Under Direct Laryngoscopy, Arch. Otolaryng. **39**:201 (March) 1944.

Adams and his associates describe the technic now employed in the administration of pentothal sodium, which is administered intravenously. They found that this method of inducing anesthesia possesses decided advantages for many types of laryngeal procedures. It permits adequate relaxation in most cases, obviates the hazards of fire and explosion, and permits a more pleasant and complication-free postoperative period for the patient than when ether is used. To produce adequate relaxation without the use of excessive doses of pentothal sodium, thorough cocainization of the glottic region is essential.

Tatti and Morton [3] developed a technic for bronchoscopic procedures under pentothal anesthesia which was found satisfactory in 600 consecutive cases. To prevent laryngeal spasm during the introduction and removal of the bronchoscope the patient was made to breathe carbon dioxide, 10 per cent, in oxygen. This obviated the need for preliminary local anesthesia to the tracheobronchial tree. They employed a preliminary dose of sedative. The carbon dioxide and oxygen mixture was given preliminary to injecting the pentothal solution and also at the termination of the bronchoscopic procedures immediately before the bronchoscope was withdrawn.

The points which make up the technic are relatively simple, but they emphasize the need of strict adherence to every detail. The method is suitable only for the experienced bronchoscopist.

BRONCHOSCOPIC EXAMINATION IN DIAGNOSIS

In a case reported by Kernan [4] a child aged 4 months had attacks of cyanosis with rapid respiratory and pulse rates, loss of voice and roentgen evidence of a widened mediastinum. The diagnoses suggested were congenital heart disease, thymic tumor, tracheal or laryngeal disease and anomalies of the great vessels. Tracheotomy was performed with no improvement. Tracheotomic bronchoscopy was then performed, and a tumor found anteriorly compressing both primary bronchi. It was soft, and the bronchoscope could easily be pushed beyond it. This resulted in improvement in the exchange of air, but there was no change in the respiratory rate. The tracheal cannula was then removed. The patient continued to have attacks of cyanosis and finally died. At necropsy there was found a mass which proved to be a greatly enlarged superior vena cava and the right innominate vein, with dilatation occurring in the vicinity of the entrance of the left innominate vein. Detailed necropsy

3. Tatti, L., and Morton H. J. V.: Pentothal Anesthesia in Bronchoscopy, Lancet **1**:597 (May 6) 1944.

4. Kernan, J. D.: Obstruction of the Right Main Bronchus Due to Congenital Maldevelopment of the Pulmonary Vein, Ann. Otol., Rhin. & Laryng. **53**:818 (Dec.) 1944.

observations are recorded in the article. These completely explain the clinical symptoms.

Abnormal swelling of the salivary glands which was associated with bronchoscopic examinations and which occurred following each bronchoscopy for a period of four years in a patient treated by Blackford [5] suggested that this be investigated.

Sialograms did not reveal the presence of either intrinsic or extrinsic mechanical obstruction of the ducts of these glands. The medication employed during bronchoscopy was investigated, and other drugs were used in experiments. Blackford presents a brief review of the applied neuroanatomy and the physiology and the pharmacologic actions of drugs used in the investigation. He states that the effects of various autonomic drugs led to the tentative conclusion that the abnormal swelling of the salivary glands is a parasympathetic reflex mediated by a sensory path over the vagus nerve and a motor path over the eighth and ninth nerves. The reflex centers involved are in the medulla.

Broncholithiasis.—Although broncholithiasis is rare it nevertheless must be considered as a possible cause of bronchial obstruction, wheezing, cough and hemoptysis. In the case reported by Anderson and Mackay [6] the bronchus was definitely obstructed to the middle lobe of the right lung, as shown by roentgen studies. Bronchoscopic examination revealed a normal trachea and right bronchus. Roentgen studies following instillation of iodized oil showed an obstruction of the bronchus of the middle lobe. Believing that they were dealing with a bronchogenic carcinoma, they decided to operate, and exploratory thoracotomy was performed. Instead of the contemplated radical pneumonectomy a middle lobe lobectomy was done, since no growth could be palpated. In dividing the bronchus they found a rough hard broncholith in an ulcerated area distal to the level of the section. The patient made an ultimate satisfactory recovery.

Benign Bronchial Stenosis.—Although benign nontuberculous bronchial stenosis is a rather common complication of infections of the respiratory tract, it is rarely recognized. In a study of this subject Schmidt [7] found that any antecedent infection of the respiratory tract such as pneumonia, severe tracheobronchitis or asthmatic bronchitis can cause bronchial obstruction. After stenosis has occurred it produces a rather typical clinical picture which is characterized by recurrent chills,

5. Blackford, R. W.: Recurrent Swelling of the Parotid and Submaxillary Glands, Following Bronchoscopy, Ann. Otol., Rhin. & Laryng. **53**:54 (March) 1944.

6. Anderson, W. S., and Mackay, J. B.: Broncholithiasis, Dis. of Chest **10**:427 (Sept.-Oct.) 1944.

7. Schmidt, H. W.: Benign Nontuberculous Bronchial Stenosis, Arch. Otolaryng. **39**:43 (Jan.) 1944.

fever, cough, purulent secretion and general malaise. The physical and roentgenographic observations vary. In some cases they indicate partial atelectasis of a lobe or an entire lung, and in others they may be negative.

Bronchoscopy is the only accurate method of diagnosing and treating such a lesion. Bronchoscopic dilation produced satisfactory results in about 66 per cent of the cases. In a certain number the stenosis recurred, and repeated bronchoscopic dilation was necessary.

A series of 25 cases of benign nontuberculous stenosis of the bronchus in which bronchoscopy was performed are reported. The oldest patient was 61 and the youngest 6 years, the average age being 34 years. In 15 of the 25 cases bronchial stenosis was secondary to asthma or asthmatic bronchitis. It appeared that severe infections and chronic irritation of the tracheobronchial tree are important etiologic factors in this type of bronchial stenosis.

CHEMOTHERAPY

While maintenance of an adequate cough reflex and airway is important in diseases of the respiratory system, the advent of new chemotherapeutic agents has aided materially in therapy, particularly from a bronchologic standpoint.

Tucker and Atkins [8] discuss the use of autogenous vaccine, particularly in connection with chronic infections of the tracheobronchial tree, and the employment of ephedrine in conjunction with bronchoscopic procedures for asthmatic patients. While many drugs have been used locally in the tracheobronchial tree for the treatment of infections, sulfonamide compounds and penicillin are the first which both are noninjurious to the lung and possess a definite therapeutic effect. They describe their method of introducing the sulfonamide drugs through the bronchoscope with the aid of a powder insufflator. The adult dose seldom exceeded 2 Gm. Examination of the bronchial secretions in patients taking sulfonamide drugs by mouth disclosed a sulfonamide level which is approximately one half that of the blood level.

Patients selected for sulfonamide medication had low grade or chronic infection of the tracheobronchial tree which proved to be resistant to the usual measures commonly employed in therapy. It was found that local application in these cases tended to reduce the intensity of the inflammatory reaction and inhibited the formation of granulation tissue in the bronchi. The reduction of edema and obstructing granulations improved bronchopulmonary drainage. While no evidences

8. Tucker, G., and Atkins, J. T.: Recent Trends in the Bronchologic Use of Chemotherapeutic and Biotherapeutic Agents, Ann. Otol., Rhin. & Laryng. **53**:777 (Dec.) 1944.

of sensitivity or toxic reactions were noted, it was found that asthmatic patients with acute symptoms did not do well with sulfonamide insufflation. In addition, several patients were observed in whom hemoptysis seemed to follow the local employment of these drugs. Discontinuance of the drugs was immediately followed by cessation of bleeding.

Penicillin has been employed in the tracheobronchial tree of tracheotomized children with acute infections. In these the drug was administered through the cannula in doses of 250 to 500 units every thirty to sixty minutes. In addition, patients with chronic tracheobronchial infections have been treated by introduction of 2,500 units of penicillin through the bronchoscope. Their studies indicated that the drug disappeared entirely from the tracheobronchial secretion in approximately twenty-four hours. It has been observed that the local use of penicillin in acute infections of the tracheobronchial tree has aided in reducing mucosal swelling and permitted a more thorough aspiration of the secretions.

Although increasing numbers of patients with chronic nontuberculous pulmonary infection are being successfully treated by surgical means, a large proportion of them either are not suitable for surgical treatment or do not desire operation. While many types of medical treatment have been instituted, the results have not been particularly satisfactory.

Vinson [9] reports on a series of approximately 100 patients with chronic nontuberculous suppurative disease of the lungs, not including pulmonary abscess, whom he treated by bronchoscopic removal of secretion from the tracheobronchial tree followed by intrabronchial insufflation of a powdered sulfonamide preparation. At least half of the patients have been benefited. The improvement varied from almost complete relief of symptoms in patients with chronic asthmatic bronchitis associated with purulent secretions to about 75 per cent reduction of cough and sputum in patients with well established bronchiectasis. No untoward effects have been observed by him.

Applebaum [10] employed sulfonamide compounds directly to the air passages in a group of 50 patients with various infectious bronchial lesions which were found refractory to other forms of therapy. These included bronchial asthma of the infectious and nonbacterial types, bronchitis secondary to sinusitis or postpneumonic in origin and also chronic bronchitis secondary to infections of the upper respiratory tract, chronic bronchitis with pulmonary emphysema and bronchiectasis. The

9. Vinson, P. P.: Treatment of Chronic Nontuberculous Pulmonary Infection by Bronchoscopy and Insufflation of Sulfonamide Compounds, Ann. Otol., Rhin. & Laryng. **53**:786 (Dec.) 1944.

10. Applebaum, I. L.: The Treatment of Bronchial Lesions by the Inhalation of Nebulized Solution of Sodium Sulfathiazole, Dis. of Chest **10**:415 (Sept.-Oct.) 1944.

response to therapy was recorded on the basis of reduction of paroxysms of cough, diminution and change in the character of expectoration, subsidence of objective signs and general improvement.

A 5 per cent solution of sodium sulfathiazole was placed in the nebulizer and connected by rubber tubing to an oxygen tank equipped with a flow meter. The patient held the nozzle of the nebulizer between the teeth and breathed with his mouth open for a period of twenty minutes. Treatments were administered three times daily for an average of ten consecutive days. Approximately 2 cc. of the solution was utilized in a single treatment.

There was no improvement in 7 cases, slight improvement in 11, moderate improvement in 15 and definite improvement in 17. Improvement therefore was noted in 43 cases, or 86 per cent of the entire series. In 2 cases local reactions were observed, and the treatment was abandoned. These occurred within twenty-four hours, and were characterized by discomfort and swelling of the nasopharyngeal mucosa. After discontinuance of treatment the symptoms subsided promptly.

Treatment failed completely in bronchial asthma due to nonbacterial inhalants. In cases of chronic bronchitis associated with pulmonary emphysema and bronchiectasis there was some improvement. The chronic bronchial lesions of bacterial origin were definitely benefited. Several illustrative reports of cases are presented.

LARYNGOTRACHEOBRONCHITIS

In the cases of laryngotracheobronchitis observed by Walsh[11] the infection seemed to ascend from the bronchioles to the trachea and larynx, and as a result laryngeal obstruction was not the paramount cause of dyspnea. Early tracheotomy, however, proved of value not for the relief of laryngeal obstruction but for the removal by aspiration of tracheal and bronchial secretions. In these cases the disease started as a relatively mild cold which was followed in about a week by increasing dyspnea, toxemia and progressive exhaustion.

The rationale of treatment was based on combating the infection and toxemia, prevention of exhaustion and maintaining an adequate airway. To accomplish this Walsh gave fluids by hypodermoclysis and sulfonamide drugs combined with bed rest. To combat tracheal and bronchial obstruction frequent aspirations following instillation of saline solution containing a vasoconstrictor were carried out. With this plan of treatment 90 per cent of a series of 101 patients recovered.

Immediately on admission the patient was placed in a moderately cool and moistened atmosphere. It was difficult to accomplish this without the aid of the Burgess box. A mixture of carbon dioxide, 5 per

11. Walsh, T. E.: Treatment of Laryngotracheobronchitis, Laryngoscope 54:87 (Feb.) 1944.

cent, and oxygen, 95 per cent, was used. Under these conditions many patients showed considerable improvement within one or two hours.

The initial dose of sulfonamide drug, usually sulfadiazine, was 0.1 Gm. per kilogram of body weight. Additional amounts of sulfadiazine were given orally every four hours, so that the total for the first twenty-four hours was equivalent to 0.3 Gm. per kilogram of body weight.

In spite of this plan of therapy improvement was not obtained in 35 per cent of the cases. In these it was felt that prompt tracheotomy was advisable. A bronchoscope was passed, and aspiration of the trachea and bronchi performed. It was noted that passage of the bronchoscope alone did not relieve the respiratory embarrassment, indicating that edema of the larynx was not the major cause of the obstructed airway. Tracheotomy was performed with the bronchoscope in situ, and as soon as the cannula was inserted isotonic solution of sodium chloride with a vasoconstrictor was instilled into the trachea, and suction instituted. It was not until thick mucus and crusts were removed that respiration improved.

The results in this series in which the principles of therapy outlined were observed were very satisfactory. A mortality rate of 14 per cent occurred in the cases in which tracheotomy had been performed, and the gross mortality for the entire series was 10 per cent.

FUSOSPIROCHETAL TRACHEOBRONCHITIS

Pulmonary suppuration and severe tracheobronchitis with local and systemic symptoms but without gross anatomic changes in the lungs may be caused by fusospirochetal organisms. Holinger and Rigby [12] studied 69 patients with chronic pulmonary infections in whom the etiologic organisms appeared to belong to the fusospirochetal group. They discuss the symptoms, the diagnosis and the plan of treatment.

The principal therapeutic agents in the treatment of fusospirochetal infections are the various arsenicals. They should be administered promptly if maximum efficiency is to be obtained. While they may be given in doses and in series similar to those employed in antisyphilitic treatments, if neoarsphenamine is used smaller doses should be given, and they should be repeated at intervals of two to four days. Intravenous injection of antimony and potassium tartrate may be used in the cases of resistant infection.

Experimental evidence has shown that fusospirochetal infections are increased in vitamin C deficiency. They therefore administered large doses of ascorbic acid and in addition suggested the use of a high calcium diet. An autogenous vaccine was employed in patients whose bronchitis was found to be chronic and who had responded inconclusively to the

12. Holinger, P. H., and Rigby, R. G.: Fusospirochetal Tracheobronchitis, Illinois M. J. **85**:141 (March) 1944.

administration of arsenicals. The most frequent organism used in the preparation of the vaccine was the Streptococcus viridans, although many other organisms frequently were found in the aspirated secretions and also were included in the preparation of some of the vaccines.

Active postural drainage was recommended for patients who had a productive cough, and bronchoscopic aspiration was carried out in those who exhibited signs of bronchial obstruction.

PULMONARY ABSCESS

Although attempts have been made to standardize the treatment for acute pulmonary abscess, there still are brought to the surgeon a large number of patients in whom there are abscesses in the chronic stage with local complications, the result of single or multiple stage drainage. In these chronic abscesses drainage is not satisfactory, and for this reason Lindskog [13] considers primary resection of the lung the procedure of choice. This is particulary so if one or more of the following conditions exist, namely, multiple abscesses or extensive destruction of one or more lobes, bronchiectasis, atelectasis or pneumonitis unrelieved by bronchoscopic treatment, uncontrolled bleeding, perforation and localized empyema. In his experience the mortality following some form of drainage was much higher than that following primary lobectomy. The occurrence of 1 death in 14 lobectomies warranted further use of this method of therapy.

In a study of 122 cases of pulmonary abscess diagnosed by roentgenographic, operative or necropsy findings, Brantigan and Looper [14] discuss the relative merits of the aspiratory and embolic theory of etiology. In a minority of cases only could the true etiologic factor be discovered. In 14 cases the abscess developed after tonsillectomy or disease of the throat, and in 28 after operations of all types. In 8 instances the abscess was caused by septicemia, suggesting that failure to expel aspirated material from the tracheobronchial tree probably is more important than aspiration alone. It would seem also that a favorable set of circumstances must be present to produce pulmonary abscess. Prophylactic measures, particularly in regard to postoperative abscesses, are discussed.

In their opinion the treatment of acute uncomplicated abscess is open drainage. Complicated abscesses give poor results, and primary lobectomy is considered the treatment of choice. Emphasis is placed on preoperative preparation, which includes appropriate dietary measures, bronchoscopic aspiration, chemotherapy and blood transfusions.

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13. Lindskog, G. E.: The Surgical Treatment of Chronic Pulmonary Abscess, Surgery **15**:783 (May) 1944.

14. Brantigan, O. C., and Looper, E. A.: The Etiology and Surgical Treatment of Lung Abscess: Importance of Lobectomy, South. M. J. **37**:199 (April) 1944.

BRONCHIECTASIS

While chronic sinusitis and bronchiectasis frequently coexist, Davison [15] expresses the opinion that one does not cause the other. In a study of case histories of 50 patients who had bronchiectasis and the case histories of 50 patients with chronic suppurative sinusitis of at least one year's duration who had no pulmonary symptoms he found that all patients who had both bronchiectasis and sinusitis were of the hypersensitive type. In 72 per cent of the 50 patients bronchiectasis developed within the first decade of life. It is believed that the allergic or hypersensitive state was an etiologic factor in 80 per cent of cases of bronchiectasis. Seventy-four per cent traced the onset of their chronic cough to an acute bronchopulmonary infection. Davison considers mucosal edema to be probably the chief factor responsible for the atelectasis which led to the development of bronchiectasis and expresses the opinion that results in the prevention and treatment of bronchiectasis would be better if more were known about allergy and methods for its control.

In a very comprehensive presentation of the problem of bronchiectasis and its management, Alexander [16] emphasizes that while the present safety of pulmonary lobectomy has solved the problem of treatment for approximately half of the patients with bronchiectasis, management of the remaining one half presents a difficult problem. He believes that nonsurgical methods of treatment, if properly applied and faithfully carried out by this group, can be made effective in greatly alleviating the distressing symptoms of the disease in a large majority, this in spite of the pessimistic opinions that have been expressed about the value of nonsurgical treatment.

In discussing the diagnosis he emphasizes the need of bronchograms for establishment of a definite diagnosis. In order to give a comprehensive opinion concerning the presence of bronchiectasis it is necessary that iodized oil be introduced in such a way that the bronchi of all five lobes of the lung are well coated. This requires a series of roentgenograms in certain specified projections that will permit an exact differentiation not only of the bronchi of the different lobes but also of the segments of the lobes, since these observations are essential for a consideration of the treatment to be employed.

Virtually every patient who has bronchiectasis or is suspected of having it should have a bronchoscopic examination. Bronchoscopic examinations alone give exact information concerning obstructing bronchial lesions, and in addition bronchoscopic aspiration following chemical

15. Davison, F. W.: Does Chronic Sinusitis Cause Bronchiectasis? Ann. Otol., Rhin. & Laryng. **53**:849 (Dec.) 1944.

16. Alexander, J.: Roles of Medicine and Surgery in the Management of Bronchiectasis, Ann. Int. Med. **21**:565 (Oct.) 1944.

shrinkage of swollen bronchial mucosa gives benefit to the patient; it should be done preceding the instillation of iodized oil.

Improved radiographic technic and advances in bronchoscopy and bronchography have aided materially in the diagnosis of bronchiectasis and have demonstrated that it is a common disease and may be diagnosed early. Joress and Robins [17] discuss certain clinical and roentgenologic aspects and express the opinion that bronchography is the method of choice in examining patients when either the clinical history or ordinary radiographs suggest the presence of a bronchiectatic lesion. They emphasize, however, that in those cases in which clinical evaluation and radiographic findings warrant a diagnosis of probable bronchiectasis, but the terminal bronchi cannot be visualized on account of inspissated secretion or stenotic lesions, preliminary bronchoscopy with aspiration of secretion will materially help to attain this end.

While bronchiectasis is a serious and often a fatal disease, it is not accorded the attention that it deserves. In a discussion of some of the clinical problems in bronchiectasis, Hinshaw and Schmidt [18] point out that bronchoscopy is frequently required in diagnosis and that bronchographic studies with iodized oil usually are necessary properly to evaluate the case. Bronchiectasis may be difficult to diagnose accurately, and often the symptoms are confused with those of chronic infection of the upper part of the respiratory tract. It may be confused with tuberculosis or with new growth. While roentgenographic study with iodized oil is useful in determining the presence and extent of the dilatations, its value is limited in excluding obstructing lesions of a bronchus. Although the site of the obstruction may be demonstrated, it usually is impossible to recognize the obstruction, and incomplete filling of the bronchi may simulate organic obstruction in cases in which such obstruction does not exist. When an obstruction is suspected, a bronchoscopic examination always should precede lung mapping. They recommend bronchoscopic examination in most cases of bronchiectasis with evidence of unilateral infiltration, in cases of recurrent attacks of respiratory infection with chills and fever and in other cases in which the possibility of a long-retained foreign body or other type of obstruction may exist.

Blades and Dugan [19] direct attention to certain late features of atypical or virus pneumonia, namely the effects of the disease on the bronchi and the production of pseudobronchiectasis. The disease has

17. Joress, M. H., and Robins, S. A.: The Diagnosis of Bronchiectasis: Clinical and Roentgenological Observations, Dis. of Chest **10**:489 (Nov.-Dec.) 1944.

18. Hinshaw, H. C., and Schmidt, H. W.: Some Clinical Problems in Bronchiectasis, Dis. of Chest **10**:115 (March-April) 1944.

19. Blades, B., and Dugan, A. J.: Pseudobronchiectasis, J. Thoracic Surg. **13**:40 (Feb.) 1944.

been variously designated as bronchopneumonia of unusual and undetermined origin, and the roentgen manifestations are at times difficult to interpret, suggesting tuberculosis or pulmonary tumor. In many instances basilar densities might easily lead to a preliminary diagnosis of bronchiectasis.

It has been found that instillation of iodized oil in pseudobronchiectasis caused by atypical pneumonia will result in observations that can be erroneously interpreted as true bronchiectasis. They emphasize that probably more important information can be obtained by inspection of the bronchial orifices and bronchial mucous membrane through the bronchoscope than by any other diagnostic procedure. The appearances of the bronchial tree in pseudobronchiectasis after atypical pneumonia is usually different from that in bronchiectasis. While pus can be seen coming from bronchi of the involved lobes or segments, usually the surface of the visible mucosa is noticeably edematous, but the tissues are not as friable as in bronchiectasis and manipulation rarely results in bleeding. Even with the presence of an enormous quantity of pus the characteristic bronchiectatic odor is not evident. The temporary alleviation of symptoms common after bronchoscopic aspiration in cases of bronchiectasis usually is not pronounced or is entirely absent in patients with pseudobronchiectasis.

Although Fernandez [20] observed no beneficial therapeutic results from the use of iodized oil in the treatment of long-standing cases of pulmonary suppuration he considers it a very important aid in diagnosis. In a review of 350 cases studied by him he discusses the technic of instillation of iodized oil for diagnosis. He employed a catheter passed pernasally into the trachea, following preliminary anesthetizing of the tracheobronchial tree with solution of cocaine. He states that he used a 10 per cent aqueous solution of cocaine in the nose and pharynx and a 5 per cent solution in the trachea. He has had several cases of cocaine poisoning and 1 fatality.

Posturing is employed to secure proper placement of the oil, which is carried out under fluoroscopic observation. This he considers as important as the roentgenographic studies. The indications and contraindications of bronchography are discussed.

Grier [21] studied a group of 40 patients with bronchiectasis for two thirds of whom an initial erroneous diagnosis of primary atypical pneumonia had been made. These were found to have a pneumonitis, complicating a preexisting bronchiectasis. In 75 per cent of the cases the bronchiectasis was unilateral, and in two thirds of these it involved only the lower lobe of the left lung. He emphasizes the importance of

20. Fernandez, C.: Bronchography, Rev. de otorrinolaryng. **3**:192 (Dec.) 1943.

21. Grier, G. S., III: Importance of Bronchography in Cases of Unresolved Pneumonia, Arch. Int. Med. **73**:444 (June) 1944.

bronchographic studies in all cases of pneumonitis which fail to resolve within four to six weeks.

TUMORS OF LARYNX, TRACHEA AND BRONCHI

Papilloma of Larynx.—Laryngeal papilloma in children, although always benign and self limited, are exceedingly serious because of the rapidity of growth, the frequency of occurrence and the common development of obstruction of the larynx. Since the symptoms are not unlike those of other forms of laryngeal obstruction, a conclusive diagnosis can be made only by direct laryngoscopic examination.

In a report based on a series of 15 cases, Ferguson and Scott [22] emphasize the importance of carrying out direct laryngoscopic examination without delay in the presence of laryngeal obstruction. The average time of onset of papilloma in children is between 18 months and 4 years. In only one case were symptoms present from birth. Since the cause of papilloma is not known, no specific treatment can be carried out. Radical measures are contraindicated, as implantations may occur on any portion of the larynx or in the trachea. Ferguson and Scott found repeated endolaryngeal excision to be the treatment of choice. The papillomas were removed with biting forceps flush with the adjacent mucosal surface. The patient should be examined every two to four weeks, and excision should be repeated as recurrences demand. The number of excisions varied from one in 3 patients to thirty-five in 1 patient, who still is under treatment. The growths usually resolve spontaneously at puberty regardless of the method of treatment. The average duration is about three years. Conservative treatment by excision during the period of activity therefore is desirable, since this preserves the normal structure of the larynx and permits normal laryngeal growth as well as development of the voice. Tracheotomy is indicated only for persistent laryngeal obstruction with dyspnea and was done in 9 of the 15 patients.

Three patients died. One died from asphyxia, when an unobserved 2 year old child removed the tracheal cannula, 1 from laryngeal dyspnea and 1 from a prolapse of a papillomatous mass into the glottic chink shortly before the scheduled excision.

Osteoma of Trachea.—While bony tumors of the tracheobronchial tree are rare and commonly produce few or no clinical symptoms, they should be considered as a possible cause of obscure hemoptysis and of tracheal obstruction. Clerf [23] reports 2 cases in which hemoptysis

22. Ferguson, S. C., and Scott, H. W., Jr.: Papillomatosis of the Larynx in Childhood, New England J. Med. **230**:477 (April 20) 1944.

23. Clerf, L. H.: Tracheopathia Osteoplastica (Osteoma of the Trachea), Ann. Otol., Rhin. & Laryng. **53**:839 (Dec.) 1944.

appeared as a prominent symptom. In 1 of these there were also purulent expectoration and intermittent dyspnea. In both instances bronchoscopic examination revealed innumerable small nodular elevations along the trachea, beginning a short distance below the vocal cords and continuing down to its lower end, as well as extending into both bronchi. These did not involve the posterior wall, being limited to that portion of the trachea supported by cartilaginous rings.

It is probable that a more general use of the bronchoscope in a study of patients with unexplained hemoptysis would reveal a larger number of these cases. Irradiation was suggested as a possible plan of therapy.

Cancer of Trachea.—Primary carcinoma of the trachea usually arises in the upper third and is of the squamous cell variety. It commonly is highly malignant and develops insidiously. In a study of 5 cases Fisher [24] found that the common initial symptom was an irritating cough with or without blood streaked sputum. The diagnosis can be made only by direct examination and biopsy.

Carcinoma of the trachea appears to spread by direct involvement of the surrounding mucosa and may perforate the posterior wall at an early stage. It metastasizes late in the course of the disease. Fisher recommends electrocoagulation of the growth through a bronchoscope with the tumor under direct vision. This should be followed by irradiation with roentgen rays of high voltage. The electrocoagulation can be repeated as often as necessary to afford adequate space for respiration. A report of 5 cases is appended.

Pierson [25] reports the case of a man, aged 61 years, who had intermittent attacks of severe cough, dyspnea and moderate hemoptysis for three years. On bronchoscopic examination there was found a tumor above the carina involving about one half of the lumen of the trachea, being attached to practically the entire cartilaginous portion for a distance of 2.5 cm. Its base was broad and firm, and the mass appeared lobulated. Histologic examination revealed an adenocarcinoma which was believed to be primary in the trachea.

Radioactive iodine was given to determine whether the tumor developed from the thyroid gland. As much as possible of the tumor was removed endoscopically, and then radium was applied intratracheally with a special applicator introduced bronchoscopically. There has been no recurrence two years after treatment, and the patient is well subjectively as well as objectively.

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24. Fisher, G. E.: Cancer of the Trachea: Report of Five Cases, Arch. Otolaryng. **40**:49 (July) 1944.

25. Pierson, P. H.: Primary Carcinoma of the Trachea, J. A. M. A. **126**:206 (Sept. 23) 1944.

Adenoma of Bronchus.—In a discussion of adenoma of the tracheobronchial tree Schwartz [26] reports 3 cases. In the first case the growth was destroyed by electrocoagulation with apparently complete recovery on the basis of roentgen studies. In the second case electrocoagulation was repeatedly applied to the broad base of the tumor, but regrowth was so rapid that within a week after removal it had attained its former size. Irradiation and implantation of radon proved ineffective, and the patient ultimately died from a cerebral accident. The third case was unusual in that the adenoma was found in the upper part of the trachea. It was attached by a broad base about ¼ inch (0.64 cm.) in diameter, the center of which was located at the level of the second tracheal ring on the right anterolateral aspect. While the growth could be grossly removed and a patent airway reestablished, it was believed that the base of the tumor could be eradicated only through a tracheotomy opening with removal of a portion of the contiguous tracheal wall. Unfortunately the patient was not inclined to follow this recommendation.

Adenoma of the bronchus is not a rare tumor, and undoubtedly in many cases the condition is never diagnosed but is considered an acute pulmonary infection, often pneumonia, and the patients are discharged on the subsidence of symptoms as cured without a final roentgen study of the chest.

In the case reported by Hill,[27] the clinical and roentgen findings were confined to the middle lobe of the right lung. It was only on repeated bronchoscopic examination and the employment of a 5 mm. bronchoscope that a tumor was observed in the bronchus of the middle lobe. Biopsy corroborated the diagnosis of bronchial adenoma. Electrocoagulation was carried out with apparently a satisfactory immediate result. Hill directs attention to the slow growth of these tumors, which often tend to recur years later. They commonly are extrabronchial, but with normal roentgen findings and an absence of clinical signs or symptoms it is believed that conservative therapy is the treatment of choice for the present.

Although so-called bronchial adenoma has come to be recognized as a fairly definite clinical and pathologic entity, gaps in the present knowledge of tumors of this type, particularly regarding their ultimate outcome, have left unsettled the matter of treatment of choice in these cases. If they are potentially malignant, as some claim, surgical extirpation should be given serious consideration in preference to any other plan of therapy.

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26. Schwartz, L.: Adenoma of the Trachea and the Bronchus, Arch. Otolaryng. **39**:231 (March) 1944.

27. Hill, F. E.: Adenoma of Bronchus Treated with Electrocoagulation, Ann. Otol., Rhin. & Laryng. **53**:844 (Dec.) 1944.

In a case reported by Laff and Neubuerger [28] a tumor in the right bronchus of a woman was discovered which caused her death thirteen and one-half years later, after having metastasized extensively to the opposite lung. The postmortem diagnosis was of adenocarcinoma. At the first bronchoscopy, performed in 1930, the biopsy report was that the tumor found in the right main bronchus was adenoma. At necropsy extensive neoplastic involvement of the left lung was found. In a second case a lesion was found which was reported as oat cell carcinoma. Pneumonectomy was performed, and the tumor mass was studied further. Neoplastic cells infiltrating through the bronchial wall were observed. In both of these cases the tumors presented different histologic patterns; in the first the rare cylindromatous form which had existed for thirteen and one-half years terminated with metastasis to the opposite lung; in the second, the commoner solid form, the tumor was at first mistaken for an oat cell carcinoma. They believe that the term "bronchial carcinoid," already employed by some authors, might be adopted in preference to "bronchial adenoma."

Carcinoma of Bronchus.—In a review of 147 cases of carcinoma of the bronchus reported by Mattick [29] it is agreed that the greatest problem in successfully treating cancer lies in the inability to make a diagnosis sufficiently early. Thirty or 40 per cent of the patients had demonstrable metastasis when first seen. Over one third were poor risks for any plan of therapy. About 10 to 15 per cent could have had exploratory thoracotomy, but surgery was rarely performed, and practically all patients treated were given some form of irradiation therapy. In a few selected cases gold radon seeds were implanted directly through a bronchoscope into the accessible cancer. Four cases, in all of which the condition was proved histologically to be carcinoma, are described in detail. The patients were treated by irradiation, and a satisfactory result for periods ranging from three to five years was attained.

In the treatment of early carcinoma of the bronchus Pohle and Siris [30] are agreed with other observers that pneumonectomy represents the method of choice. Unfortunately, in the vast majority of cases bronchogenic carcinoma is no longer operable when the patients present themselves for diagnosis. In many, metastases have already occurred when the patients are first seen. It is difficult therefore to answer fairly from any survey the question of curability of carcinoma of the bronchus by irradiation.

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28. Laff, H. I., and Neubuerger, K. T.: Bronchial Adenoma with Metastasis, Arch. Otolaryng. **40**:487 (Dec.) 1944.

29. Mattick, W. L.: Some Experiences in the Treatment of Bronchial Cancer, Am. J. Roentgenol. **52**:24 (July) 1944.

30. Pohle, E. A., and Siris, E. L.: Roentgen Rays in the Treatment of Carcinoma of the Bronchus, J. Thoracic Surg. **13**:67 (April) 1944.

A series of 69 cases of carcinoma of the bronchus are analyzed, and data are tabulated concerning the age of the patients, sex incidence, histopathologic observations, average duration of symptoms before the diagnosis, survival of the patients after the first course of therapy, the survival period in current cases and the total survival period from the known onset of symptoms in completed cases. They express the opinion that, though in rare instances even in the presence of metastases a five year survival may be achieved, the greatest value of irradiation therapy in patients with carcinoma of the bronchus lies in its palliative effect, and they recommend giving it a trial so long as the general condition of the patient permits.

Fremont [31] reports the case of a man aged 53 years in which a diagnosis of squamous cell carcinoma of a bronchus was made on the basis of a bronchoscopic biopsy. The growth involved a dorsal division of the right lower lobe bronchus. No roentgen irradiation was carried out, but nine radon seeds of the Muir type each containing 1.6 millicuries of radon were inserted around the site of the growth. The patient remained afebrile, and there was no systemic reaction. Within three months the pain and dyspnea had completely disappeared. Frequent radiographic check-ups revealed clearing of the shadow in the right lower part of the chest. A bronchoscopic examination almost seven years after the diagnosis had been made showed some constriction of the lumen of the branch bronchus, but there was no evidence of growth. Fremont is of the opinion that radium, although used in fewer cases than roentgen rays, appears to yield better results.

There is a high incidence of intracranial metastasis in cases of bronchogenic carcinoma. In a study of a series of 448 cases of microscopically proved carcinoma of the bronchus, Tinney and Moersch [32] found that in 52, or 12 per cent, there were symptoms referable to the nervous system.

In 19 cases, or 4 per cent, symptoms referable to the nervous system were the prominent ones. A localized intracranial lesion was suspected in 8 cases, and 2 patients underwent exploratory craniotomy. Necropsy was performed in 70 cases, and in 19 per cent of these cerebral metastasis was found. Tinney and Moersch emphasize the importance of a thorough general examination including a routine roentgenogram of the thorax in every case in which an intracranial or an intraspinal lesion is suspected. The type of carcinoma was not a factor in the incidence of metastasis to the nervous system.

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31. Fremont, D. A.: Seven Year Cure in a Case of Carcinoma of the Bronchus, Brit. M. J. **1**:845 (June 24) 1944.

32. Tinney, W. S., and Moersch, H. J.: Intracranial Metastasis of Carcinoma of the Lung, Arch. Otolaryng. **39**:243 (March) 1944.

Mediastinal Tumors.—In a study of dermoid cysts and teratomas of the mediastinum based on the world literature and a report of 6 personal cases, Rusby [33] discusses the clinical and diagnostic phases and refers to bronchoscopy. He believes that bronchoscopic examination is of limited value and states that it is confined to demonstrating a narrowed lumen of the bronchus from pressure exerted from without. If the tumor is cystic and a fistula exists more information may be expected. By bronchoscopic aspiration one might secure some of the contents of the cyst; if pus was found welling up from the bronchi distal to the opening of the cyst one might suspect secondary bronchiectasis. In 1 of the cases reported a portion of tissue removed bronchoscopically bore a close resemblance to skin and did not suggest bronchial mucous membrane. This biopsy strongly suggested a tumor of the dermoid type.

Tuberculous Tracheobronchitis.—While tuberculous tracheobronchitis has been regularly recognized only in the past decade, it appears to be very important clinically. The occurrence, mode of involvement, types, intensity and causative factors still are being investigated. Certain points are not clear, including possible reasons for its selective occurrence.

Observing that a number of patients who were found to have tracheobronchial lesions also exhibited clinical evidences of an allergic background, Oatway and his associates [34] studied a group of 100 patients suspected of having tuberculous tracheobronchitis. These were examined bronchoscopically at least once. Eighty per cent were found to have some evidence of tuberculous tracheobronchitis, and of these 75 per cent were women. Routine studies were made, including a blood count, with eosinophil study both of the blood and the bronchial secretions and with additional examinations together with cutaneous tests and tuberculin tests.

It was found that patients with tuberculous tracheobronchitis reacted more strongly to routine cutaneous tests than tuberculous patients without such lesions. While tuberculous tracheobronchitis occurred more frequently in women than in men, the most serious bronchial lesions occurred predominantly in women patients with clinical evidences of allergy. Patients with tuberculous tracheobronchitis were not unusually reactive to tuberculin by cutaneous tests; however, those who were most sensitive to tuberculin were most sensitive also to the routine allergens by cutaneous tests. There was an apparent direct relationship between a personal history of allergy and the presence of tuberculous tracheobronchitis.

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33. Rusby, N. L.: Dermoid Cysts and Teratomata of the Mediastinum, J. Thoracic Surg. **13**:169 (June) 1944.

34. Oatway, W. H., Jr.; Gale, J. W., and Mowry, W. A.: Allergy and Tuberculous Tracheobronchitis, J. Thoracic Surg. **13**:1 (Feb.) 1944.

In a study of 95 adult patients with pulmonary tuberculosis, McConkey and Gordon [35] found 61 who had persistent rhonchi unrelieved by cough. In their experience the development of persistent sonorous rhonchi unrelieved by cough during the course of pulmonary tuberculosis signified with rare exception the presence of bronchial stenosis. It is important to bear in mind that these are often described by patients as "wheezing." This sign is more pronounced during expiration and may be heard only at the end of forced expiration.

For 58 of these the diagnosis of a stenotic lesion of a major bronchus was verified by bronchoscopic examination. A retrograde lens to increase the field of vision was used in the bronchoscopic examination. The most commonly encountered lesion was a localized bronchitis. In addition, ulcerative hyperplastic granulations and fibrostenotic lesions were observed. They emphasize that the occurrence of persistent rhonchi in the course of pulmonary tuberculosis justifies a diagnosis of bronchial stenosis but that bronchoscopic examination is necessary to determine the appearances and extent of the lesion as well as the degree of stenosis.

Hanckel [36] reports an interesting case of pulmonary tuberculosis in which a bronchoscopic examination was made to determine the cause of a positive sputum in spite of an adequate collapse of the right lung and the reason for the occurrence of paroxysms of severe dyspnea which necessitated emergency tracheotomy. On examination with the bronchoscope the trachea was found filled with tuberculous granulations which continued down to the carina and also involved the orifice of the left main bronchus, producing moderate stenosis. It was necessary to maintain the bronchoscope in situ for a considerable time, but in spite of this the patient succumbed. The commonly accepted belief that bronchiectasis limited to an upper lobe is tuberculous and if limited to a lower lobe is nontuberculous probably has contributed to errors in diagnosis. Mitchell and Thornton [37] report 5 cases of tuberculosis associated with bronchiectasis involving a lower lobe. These represent 5 per cent of the cases of bronchiectasis observed at their clinic during the past ten years. The lesions were unilateral, but this was not of diagnostic importance, for nontuberculous bronchiectasis often is unilateral. They suggest as aids in the diagnosis of tuberculosis associated with bronchiectasis the following: a suggestive history, roentgenologic evidence of tuberculosis

35. McConkey, M., and Gordon, J.: Tuberculous Stenosis of Major Bronchi: Its Diagnosis by Rhonchi, Verified by Bronchoscopy, Am. Rev. Tuberc. **49**:140 (Feb.) 1944.

36. Hanckel, R. W., Jr.: The Use of a Bronchoscope to Maintain an Airway: Report of a Case, Laryngoscope **54**:402 (Aug.) 1944.

37. Mitchell, E. B., and Thornton, T. F., Jr.: Lower Lobe Bronchiectasis Associated with Tuberculosis, Am. Rev. Tuberc. **49**:38 (Jan.) 1944.

elsewhere in the lung, the presence of bronchial stenosis and a unilateral lesion.

In a radiographic diagnosis of pulmonary disease often the conventional roentgenogram is insufficient, particularly in those cases in which a part or the whole of a lung is obscured by previous inflammation of the pleura following pneumothorax or other forms of therapy. Dormer and others [38] recommend that bronchographic and tomographic procedures should be employed in such cases, and state that if a tomographic apparatus is not available bronchographic examination often will act as a substitute provided a clear detailed view of the lesions overlying blacked-out areas of the lung is secured. Seven cases are reported in which a radiographic black-out of 1 lung field was studied by bronchography. They consider this method of study of pulmonary lesions of value in diagnosis.

Believing that if a sputum containing acid-fast bacilli belonging to a pathogenic group is found one ought to demonstrate radiologically definite pathologic changes in the lungs, Dormer and others [39] studied several such cases and report their findings in 5. If nothing definite could be ascertained from conventional radiograms, bronchographic studies employing a technic described by them were carried out, and in each case they succeeded in demonstrating abnormal changes in the lungs to account for the positive sputum. It was interesting to note that the early lesion in tuberculosis nearly always was a bronchiectasis or a dilated bronchus terminating in a cavity.

DISEASES OF THE ESOPHAGUS

Anatomic Variations.—Interest in the areas of deficiency of muscular coats in the esophagus, chiefly about the triangular undefended space on the posterior wall of the upper third, led Brandenburg [40] to study this subject and to carry out a series of dissections. The pharyngoesophageal segment was studied in 41 dissections. This work was directed to the muscular coat surrounding the esophagus with special attention to the so-called esophageal triangle located below the cricopharyngeus muscle. Data secured at necropsy with measurements of the triangle and illustrations are included in the article. Brandenburg is agreed that hernias, notably pulsion diverticulum, bear a direct relationship to tissue integrity and muscle protection. With variations in the musculature there is an additional factor contributing to formation of hernias. Pulsion divertic-

38. Dormer, B. A.; Friedlander, J., and Wiles, F. J.: Bronchography in Pulmonary Tuberculosis: Radiographic Black-Out-Evaluation of Underlying Lesions, Am. Rev. Tuberc. **50**:287 (Oct.) 1944.

39. Dormer, B. A.; Friedlander, J., and Wiles, F. J.: Bronchography in Pulmonary Tuberculosis, Am. Rev. Tuberc. **50**:283 (Oct.) 1944.

40. Brandenburg, N. B.: Musculature Variations of the Pharyngoesophageal Segment, Laryngoscope **54**:136 (March) 1944.

ulum of the esophagus bears the same direct relationship to congenital muscular variations of the pharyngoesophageal segment and of Laimer's triangle as does inguinal hernia to the triangle of Hesselbach. Dissections showed conclusively that the structure as well as the distribution of the muscle bands over the posterior surface of the esophagus causes a considerable variation in the muscular protection of the pharyngoesophageal segment and are an unquestioned contributing factor in the occurrence of pharyngeal diverticulum.

Stricture of the Esophagus.—Cicatricial stenosis of the esophagus, the result of corrosive burns, is one of the most difficult problems in pediatric practice. Crowe [41] analyzed 57 cases of ingestion of caustic alkali. In the early cases the use of Bokay prophylactic dilation was carried out. Only 13 of the patients, however, were seen sufficiently early to permit this plan of therapy. In 9 of these no stricture of the esophagus occurred, while in 4 the treatment at home was not sufficiently prolonged, and strictures developed necessitating a second admission to the hospital and treatment of the stricture by one of the other plans of therapy. In 44 who did not have Bokay treatment strictures developed. All of these required peroral esophagoscopic bouginage, retrograde bouginage through an artificial gastric fistula or peroral bouginage with a silk thread used as a guide. There were 4 fatalities. He recommends the employment of the Bokay prophylactic method with an eyeless catheter which has been filled with lead shot or mercury tied off at the open end. This should be gently passed down the child's esophagus and left in place for five minutes, starting the third day after the lye had been swallowed. The catheter should not be forced but allowed to pass by weight of the shot or mercury contained in it. During the first few days the size of the catheter should be increased until difficulty is encountered in passing it. From the third to the tenth week the largest possible catheter should be passed once daily and kept in place for ten to thirty minutes. The catheter should be introduced twice a week for the next month, then once a month for at least three months, and then the interval can be lengthened to suit the patient's condition.

In the management of a recent case of ingestion of caustics it is important to prevent the occurrence of complete esophageal obstruction. Adams and Hoover [42] present 2 cases of complete stricture of the midesophagus in which cicatricial obliteration of the lumen had occurred. In the first case it was possible to reestablish a lumen through a mass

41. Crowe, J. T.: Poisoning Due to Lye: Value of Bokay Prophylactic Dilation in Prevention of Early Stricture of Esophagus, Am. J. Dis. Child. **68**:9 (July) 1944.

42. Adams, R., and Hoover, W. B.: The Management of Stricture of the Esophagus, J. Thoracic Surg. **13**:383 (Oct.) 1944.

of granulation tissue, but an acute suppurative mediastinitis developed. Recovery from this was followed by appropriate retrograde bouginage, and the patient made a satisfactory recovery.

In the second case the cicatricial obliteration was of seven years' standing, and it was necessary to reestablish the esophagus for a distance of 2 cm. in its midportion. A mediastinotomy was performed, an esophagoscope was advanced to the stricture both perorally and through the gastrostomy opening and an aspirator was introduced through the lower esophagoscope. The surgeon held the fibrous occluded esophagus between his fingers and guided the probe along its central portion. A new lumen was gradually established without perforation. A thread was drawn through the stricture and later retrograde dilation was instituted.

The writers emphasize the importance of having the patient swallow a thread promptly after injury to the esophagus if there is any difficulty in taking liquids. This maintains a potential lumen even after extensive corrosive injury and also furnishes the essential guide for later dilation either by retrograde methods or by passing a bougie from above.

Pellagra.—There is a scant literature concerning the esophageal lesions in pellagra. Fisher [43] reports on the esophagoscopic findings in 17 pellagrins, all of whom were complaining of severe dysphagia. Examination of the mouth revealed characteristic glossitis in every instance. Anorexia, burning of the tongue and abdominal pain were common complaints. The intense glossitis, stomatitis and gingivitis gradually resulted in pronounced dysphagia. The discomfort often became so intense that many could not take solid food, and a fairly large group had discomfort when they swallowed liquids.

Fisher employed a 9 mm. esophagoscope under local anesthesia for examination of the esophagus. All the patients exhibited an esophageal mucosa which was intensely hyperemic and in some cases edematous. Multiple tiny ulcerations of the mucosa of the esophagus were noted in 9 cases. There was no tumor or foreign body found in any case. Roentgen studies of the esophagus with barium in 8 cases revealed many small constricted areas along its course. These constrictions occurred in areas where ulcerations were observed on esophagoscopic examination.

Each patient was given 150 mg. of nicotinamide, 15 mg. of thiamine hydrochloride and 15 mg. of riboflavin daily for three months. They were then given normal maintenance doses of vitamins.

After the treatment noted this group of patients could swallow without any discomfort in from three weeks to two months. All improved remarkably in their general health, and the stomatitis and associated

43. Fisher, G. E.: The Esophageal Manifestations of Pellagra, South. M. J. **37**:446 (Aug.) 1944.

dermatitis continued to show improvement. Several reports of cases are appended.

Achalasia.—The orthodox treatment of achalasia of the cardia is directed toward allaying inflammation of the esophagus and encouraging the passage of food into the stomach. This is accomplished by placing the patient on a bland liquid and soft diet, avoiding highly seasoned foods or foods with coarse roughage. If pronounced esophagitis is present it may be necessary to irrigate the esophagus daily with hot isotonic solution of sodium chloride. Since many of these patients are nervous a mild sedative is beneficial, and one of the barbiturates usually is given. The most important part of the treatment has been dilation of the cardia with some form of expanding dilator.

In a study of the subject, Moore [44] adds thiamine hydrochloride to the regimen of treatment commonly employed. The initial injection, given intramuscularly, varied from 10 to 20 mg. The injections were given every second or third day in conjunction with the other recognized procedures. When swallowing improved so that food passed with ease into the stomach without retention and stagnation the thiamine hydrochloride was given by mouth in doses of 10 mg. three times daily fifteen minutes before meals. It is important that the thiamine hydrochloride is given intramuscularly so long as there is retention of food in the esophagus, because during this phase if given by mouth it will not be absorbed properly and the benefits will be minimal.

While it probably is too early to arrive at final conclusions, enough benefit was observed in a small series of cases to suggest that it may be a valuable aid. The possibility also is suggested that achalasia may be reversible if treatment can be instituted early enough, before degeneration of the nerve mechanisms has progressed too far.

Mediastinitis.—Perforation of any portion of the esophagus presents immediate problems of unusual gravity which call for prompt yet carefully considered methods of management. In the case reported by Heatly,[45] treatment with the esophagoscope and dilation with a pneumatic dilator of a cardiospasm under general anesthesia were followed seven hours later by sudden severe pain in the substernal region and chilly sensation. Mediastinal and later subcutaneous emphysema of the tissues of the neck was demonstrated. A diagnosis of perforation of the lower third of the eosophagus with mediastinitis was made. Oral feedings were discontinued and infusions of isotonic solution of three chlorides U. S. P. and sulfadiazine given with definite clinical improvement. On

44. Moore, T. M.: Achalasia of the Cardia (Cardiospasm); Thiamine Chloride as an Adjunct in Treatment, Laryngoscope **54**:345 (July) 1944.

45. Heatly, C. A.: Perforation of Lower End of the Esophagus: Chemotherapy; Gastrostomy; Recovery, Ann. Otol., Rhin. & Laryng. **53**:793 (Dec.) 1944.

the fourth postoperative day a gastrostomy was performed. The patient made a slow but satisfactory recovery, the gastrostomy tube being removed on the twenty-third day.

Simpson [46] reports 2 cases of mediastinal complications associated with esophagoscopic procedures. The first, a patient with dysphagia of eight months' duration, had fever and severe substernal pain twenty-four hours after treatment with the esophagoscope under local anesthesia. There were considerable swelling and tenderness of the neck, but at no time was there emphysema. Roentgen study revealed increased density extending from the right hilus. The patient died five days after treatment with the esophagoscope, following the sudden development of dyspnea. The autopsy report revealed carcinoma of the esophagus with abscess of the right mediastinum and the wall of the esophagus.

In the second case there was treatment with the esophagoscope for removal of a chicken bone swallowed twenty-four hours previously. One hour after the treatment the patient complained of pain in her back and deep in the chest, particularly on the left side. Pronounced subcutaneous and mediastinal emphysema developed with atelectasis of the lower lobe of the left lung. Eight hours following treatment with the esophagoscope incision was made along the left sternomastoid muscle, and the esophagus exposed. No foreign body or perforation was observed. With drainage and sulfonamide therapy the patient made a slow but satisfactory recovery.

Tumors of the Esophagus.—Benign Tumors: Benign tumors of the esophagus are relatively infrequent, and the subjective symptoms and clinical manifestations often are meager, which renders clinical recognition difficult. They are of interest both to the esophagoscopist and to the surgeon. In the cases reported by Harrington and Moersch,[47] 7 in number, 5 patients were treated by esophagotomy and 1 by resection of the esophagus, and in 1 case the tumor was removed perorally with a snare and cautery.

Benign tumors may be divided into two main groups, the mucosal and the extramucosal tumors. The mucosal tumors often are pedunculated and arise from the submucosa. They usually are fibrolipomas or fibromyxomas and are covered by normal esophageal epithelium. The extramucosal tumors arise from the muscle of the esophageal wall, do not involve the mucosa and usually are leiomyomas.

Since the growth of benign tumors is slow, they may attain considerable size without giving rise to subjective symptoms. This is particularly

46. Simpson, W. L.: Mediastinal Complications Associated with Esophagoscopy, Ann. Otol., Rhin. & Laryng. **53**:791 (Dec.) 1944.

47. Harrington, W., and Moersch, H. J.: Surgical Treatment and Clinical Manifestations of Benign Tumors of Esophagus with Report of Seven Cases, J. Thoracic Surg. **13**:394 (Oct.) 1944.

true of the extramucosal tumors, which rarely produce obstruction of the esophagus unless they assume great size. The common symptoms are dysphagia, substernal pain, regurgitation, cough and dyspnea. Tumors with long pedicles often are regurgitated into the mouth, and this may be the first symptom. Regurgitation of these into the nasopharynx or oropharynx can imperil life because of blocking of the airway which may result in strangulation.

Esophagoscopic examination is of utmost importance in establishing a diagnosis, although at times it may be difficult to determine the site of origin as well as the type of the tumor because of inability to secure a biopsy through the normal esophageal mucosa. The point of attachment of pedunculated tumors can be definitely determined, and if ulceration is present there is no difficulty in securing a biopsy. The indications for treatment are not as urgent as for malignant lesions of the esophagus unless the tumor is pedunculated and has its origin high up in the esophagus. In one of the cases reported the tumor had been regurgitated into the mouth on several occasions. It was successfully removed by bringing the tumor into the mouth, slipping a snare over it and under esophagoscopic guidance placing the snare about the base of the pedicle just below the level of the cricoid cartilage. The tumor proved to be a polypoid fibrolipoma.

Benign tumors of the esophagus are of special interest because of their rarity and the fact that they may obtain considerable size without the production of esophageal symptoms. Moersch and Harrington [48] emphasize the importance of considering tumors of the esophagus a diagnostic possibility in every case of dysphagia and suggest that care be exercised to distinguish between these and malignant tumors, which are relatively common. This is important particularly from a therapeutic standpoint, for benign tumors are amenable to treatment while malignant tumors are resistant.

In a study of 11,000 patients who had dysphagia they found 15 cases of benign tumor. It was of interest to note that their occurrence is more common, however, for in a review of 7,459 postmortem examinations there were found 44 instances of benign tumor.

In their group of 15 tumors, 9 were of the mucosal type and 6 of the intramural, extramucosal variety. While they may arise from any point in the esophagus, the lower third appears to be the most frequently involved. Large pedunculated tumors, however, were more often observed in the upper end of the esophagus. Tumors may be single or multiple, the single tumors being twice as common as the multiple. Mucosal tumors are generally sessile and frequently become pedunculated. This is probably due to the peristaltic action of the esophagus, which tends to elongate and

48. Moersch, H. J., and Harrington, S. W.: Benign Tumors of the Esophagus, Ann. Otol., Rhin. & Laryng. **53**:800 (Dec.) 1944.

mold the tumor, giving rise to a pedicle which varies in length and thickness.

With the pedunculated type of tumor which may be regurgitated into the mouth diagnosis is easy. In all other cases, however, diagnosis is difficult, and the tumor may even escape detection until revealed at necropsy. Esophagoscopic examination can be of considerable value in diagnosis, but contrary to statements in the literature dealing with the problem of benign tumors of the esophagus the diagnosis cannot always be made by esophagoscopic examination. This is attributable to the fact that most benign tumors are covered with normal mucosa and usually are so interpreted. For this reason it is not possible to obtain a satisfactory biopsy. Difficulty is encountered particularly in the esophagoscopic differentiation between intramural and extramucosal tumors and the extraesophageal tumors which press on the esophagus, producing deformity.

Reports covering the series of 15 cases are included in the article and give the esophagoscopic findings and methods of treatment.

Cancer of Esophagus: While primary carcinoma of the esophagus is a common cause of dysphagia, secondary involvement must be considered. Toreson [49] analyzes 26 cases of secondary involvement of the esophagus by cancer. Nineteen of these were encountered among 599 consecutive cases of cancer in which necropsy was performed. Of the 26 cases partial or complete obstruction of the esophagus with corresponding clinical symptoms were encountered in 12. In 3 of these the involvement of the esophagus was by metastasis from a distal primary tumor. In somewhat less than half of the cases there was definite dysphagia.

FOREIGN BODIES IN AIR AND FOOD PASSAGES

Judge [50] reports the case of a penetrating foreign body, a shell fragment which penetrated the neck and cricothyroid membrane and lodged in the ventricle of the larynx on the side opposite to its original entry. The metallic object could readily be demonstrated on the roentgenograms of the neck, but when first examined by mirror laryngoscopy the swelling of both ventricular bands and crusted exudate in the posterior commissure obscured a satisfactory view. Later, however, when the swelling and inflammatory reaction subsided the object could be seen protruding into the glottic chink. It was removed by direct laryngoscopy with little difficulty, and the patient made a satisfactory recovery.

In a report of 129 foreign bodies removed from the air and food passages, Fisher [51] reemphasizes many important points in the diagnosis

49. Toreson, W. E.: Secondary Carcinoma of the Esophagus as a Cause of Dysphagia, Arch. Path. **38**:82 (Aug.) 1944.

50. Judge, A. F.: An Unusual Foreign Body in the Larynx: Case Report, Arch. Otolaryng. **40**:60 (July) 1944.

51. Fisher, G. E.: Foreign Bodies in the Esophagus and Lower Respiratory Tract, J. M. A. Alabama **13**:220 (Jan.) 1944.

and treatment. Patients should never be inverted and shaken in an endeavor to help them cough up a foreign body. Pushing down blindly to dislodge a foreign body in the throat is not only unwise but unsafe. It is important to remove as promptly as possible vegetal foreign bodies from the tracheobronchial tree because of the severe inflamatory reaction that commonly results. While roentgenograms are of great assistance to the bronchoscopist in diagnosis, a negative roentgen report should not be accepted as absolute evidence in a case of suspected nonopaque foreign body in the tracheobronchial tree. Peroral endoscopy is still the safest method of removal and should not be withheld when indicated.

In the case reported by Foster [52] a marble had lodged in the upper part of the esophagus of a child aged 5, and was so tightly wedged that it was impossible to get forceps around it. Two unsuccessful attempts at esophagoscopic removal were made. It was then decided to resort to external surgery. The esophagus was exposed, and an attempt was made to move the marble up with the fingers, but this too was impossible. An incision was then made in the esophageal wall and the marble removed. There seemed to be nothing unusual in the structure of the esophagus. The wound healed satisfactorily, and recovery was uneventful.

Silber and his associates [53] describe an effective method of removing metallic foreign bodies which are magnetic from the stomach. In their case a child 5½ years of age had swallowed a metal padlock. After appropriate medical treatment had been carried out and after a sufficiently long wait, the magnet was passed into the stomach under fluoroscopic control, contact made with the bow of the magnet and the foreign body removed. The use of the magnet may simplify many of the more complicated procedures for removal of gastric foreign bodies from the stomach, and the method certainly warrants further exploration.

Equen [54] describes a magnet which he has found useful in the removal of foreign bodies from the tracheobronchial tree and esophagus and particularly from the stomach. The disadvantage is that only a minority of foreign bodies either aspirated or swallowed are magnetizable, which limits the field of usefulness of this type of equipment. The magnet for bronchoscopic use is attached to a small Levine tube equipped with a rubber bulb so that the stomach may be inflated. This too is employed under fluoroscopic guidance.

52. Foster, J. H.: Impacted Foreign Body in the Esophagus Requiring External Operation for Removal, Ann. Otol., Rhin. & Laryng. **53**:795 (Dec.) 1944.

53. Silber, S.; Kaplan, C., and Epstein, B.: The Use of a Permanent (Alnico) Magnet in the Peroral Removal of a Metallic Foreign Body (Padlock) from the Stomach, Ann. Otol., Rhin., & Laryng. **53**:589 (Sept.) 1944.

54. Equen, M.: A New Magnet for the Removal of Foreign Bodies from the Food and Air Passages, Ann. Otol., Rhin. & Laryng. **53**:775 (Dec.) 1944.

Roberts [55] reports on the use of an apparatus previously devised by him which relies on no measurements but rather on direct visual guidance at the time of operation for removal of foreign bodies not only from the eye but also from the air and food passages. The equipment permits one to move quickly and accurately in the removal of foreign bodies and overcomes certain of the delays in biplanar roentgenoscopic examination, notably the slow and constant shifting from one plane to another. This is completely overcome with Roberts' triangulation roentgenoscope in which only one fluoroscopic screen is used, and from this any and all positions of the foreign body, forceps and tube can be determined. Every movement of the foreign body or instrument is before the roentgenoscopist at all times in all three planes, so that all three dimensions can be observed instantaneously. On the basis of the claims made by the author this method is worthy of investigation.

Postbronchoscopic Complications.—Rosedale and Harkey [56] present a detailed report in the case of a 2½ year old child with a peanut in the left main bronchus. The foreign body was removed by bronchoscopic treatment, but tracheotomy became necessary two days later because of subglottic edema. Extensive subcutaneous emphysema developed. Two days later a right pneumothorax with 60 per cent collapse of the upper lobe of the right lung was discovered. The lung reexpanded and the patient was discharged well ten days later.

Four mechanisms for development of pneumothorax in cases of bronchial foreign body are reviewed. These are trauma to bronchial mucosa with intrapulmonic interstitial emphysema and rupture through the visceral pleura, dissecting extrapleural pneumothorax with rupture through a bleb in the parietal pleura, foreign body emphysema causing rupture of preformed pulmonary coalesced alveoli resulting in visceral subpleural bleb and surgical injury to the pleural dome during tracheotomy.

Hammond [57] reports the case of a child, aged 18 months, in which massive mediastinal and subcutaneous emphysema developed as the result of a check valve obstruction of the bronchus by a piece of apple which had been aspirated into the tracheobronchial tree. The increased pulmonary pressure secondary to the obstruction of the bronchus by the foreign body was aggravated by the straining during bronchoscopic exami-

55. Roberts, W. E.: Direct Visual Guidance, Triangulation Roentgenoscopy for the Removal of Opaque Foreign Bodies, Am. J. Roentgenol. **52**:327 (Sept.) 1944.

56. Rosedale, R. S., and Harkey, J. M.: Foreign Body in Bronchus with Pneumothorax Occurring in Opposite Side of Chest, Ohio State M. J. **40**:41 (Jan.) 1944.

57. Hammond, A. E.: Emergency Cervical Mediastinotomy in a Case of Massive Mediastinal and Subcutaneous Emphysema Secondary to Removal of a Foreign Body from the Bronchus, Ann. Otol., Rhin. & Laryng. **53**:829 (Dec.) 1944.

nation. A rupture of the alveoli apparently followed with the escape of air along the blood vessels through the mediastinum, after which there was generalized extension of air over the whole body by way of the sheaths of the blood vessels. The rapid and continued passage of air into the body tissues led to ballooning and extreme cyanosis. An emergency cervical mediastinotomy was performed. A large quantity of air was found in the subcutaneous tissues. The dissection was carried down to the trachea and laterally into the vascular sheath and was continued down below the sternum with continuous release of air. Within a few minutes respirations appeared normal. After two days the patient's condition improved, and ultimately he made a complete recovery.

In a search of the literature Cory [58] was unable to find any record of air embolism following use of the bronchoscope. He reports such an occurrence in a case of a man, aged 30 years, who previously had a putrid abscess of the lung and then had a cylindric and saccular bronchiectasis at the site of the old abscess. Although surgical treatment was suggested this was not carried out, and he was given an occasional bronchoscopic treatment whenever pus became fetid.

Treatment with the bronchoscope following which there was air embolism was not remarkable, and the findings were no different from those previously noted. There was a slight trickle of blood from one of the lower bronchial branches as the aspirator was withdrawn. About one and one half hours later the patient experienced what appeared to be a psychosis, but shortly after this there occurred convulsions which began in the right arm and leg and quickly became generalized, causing pronounced spasm. Cerebral embolism appeared the most likely diagnosis, and this was confirmed by ophthalmoscopic examination of the ocular fundi before death occurred.

At necropsy the diagnosis of bronchiectasis was corroborated, and at one spot there was a very small tear in the wall of a vein about 2 mm. in diameter. It is possible that the tear may have been made at necropsy, but it is also probable that this was the tear made by the bronchoscopic aspirator and the one that admitted air into the circulation. The findings suggest that treatment should consist of keeping the patient's head down on any occasion when bleeding is seen to occur after deep instrumentation of the bronchial passages.

Mediastinal Emphysema.—Spontaneous mediastinal emphysema is of rare occurrence. Iglauer [59] reports the case of a 3 year old child on the front of whose neck a swelling developed about six hours after a moderate paroxysm of coughing. This extended up the neck and later involved the

58. Cory, R. A. S.: Death from Air Embolism Following Bronchoscopy: Case Report, J. Thoracic Surg. **13**:30 (Feb.) 1944.

59. Iglauer, S.: Spontaneous Mediastinal Emphysema: Report of a Case, Ann. Otol., Rhin. & Laryng. **53**:823 (Dec.) 1944.

face. Roentgen studies revealed marked emphysema in front of the heart and also in the superior and posterior mediastinum, pushing the esophagus and pharynx away from the vertebral column. A diagnosis of spontaneous mediastinal emphysema was made, but it seemed desirable to rule out a foreign body as a causal factor. Use was made of the bronchoscope with negative results. Tracheotomy was then done. Considerable air was encountered when the subcutaneous tissues were incised. The patient was placed in an oxygen tent, and sulfathiazole medication was instituted. By the fourth postoperative day the emphysema began to diminish, and the patient's general condition improved; she was discharged from the hospital twelve days after operation.

Johnson [60] reports the case of a child previously tracheotomized for acute laryngeal stenosis. Bilateral pneumothorax developed when the tracheal cannula, which had been removed, could not be reinserted, making it necessary to open the tracheotomy wound. He agrees that introduction of a bronchoscope preliminary to tracheotomy will prevent pneumothorax and mediastinal emphysema.

Bilateral pneumothorax may be caused by direct injury to the pleural domes, either during tracheotomy or during unsuccessful attempts at reinserting the tracheal cannula, by rupture of air from alveoli into the interstitial tissues of the lung with migration of air to the mediastinum and by rupture from there into the pleural spaces or, most probably, by the strong inspiratory movements of the patient sucking air into the mediastinum with eventual rupture of one or both pleural spaces.

Perforation of Vessel by Foreign Body.—Hemorrhage from erosion of large vessels following ingestion of sharp pointed foreign bodies is comparatively unusual. In the case reported by Kearney [61] the patient, a man, complained of intense pain between the scapulas following the swallowing of a fish bone twenty-four hours previously. Roentgen study of the chest and esophagus revealed nothing. A tentative diagnosis of esophageal foreign body was made, but careful esophagoscopic examination revealed no evidence of either foreign body or injury. The patient's symptoms subsided, and he was discharged. He was again observed two months later with pain referable to the right lumbar region which was considered of probable renal origin. Appropriate studies were carried out with essentially negative results except for fixation of the right kidney. Exploratory laparotomy revealed a huge retroperitoneal clot with a definite odor of urine. The source of the bleeding could not be found. The patient died. At autopsy an opening in the right renal artery was found from which protruded a bone, 3 cm. in length. No perforation

60. Johnson, L. M.: Bilateral Pneumothorax in a Tracheotomized Patient, Ann. Otol., Rhin. & Laryng. **53**:837 (Dec.) 1944.

61. Kearney, H. L.: Fatal Hemorrhage from Perforation from Right Renal Artery by Fish Bone, Ann. Otol., Rhin. & Laryng. **53**:797 (Dec.) 1944.

of the esophagus or the gastrointestinal tract was found to indicate the path of the needlelike foreign body to the renal artery.

TECHNIC FOR GASTROSCOPY

To overcome some of the difficulties encountered in use of the flexible tube gastroscope, namely, to eliminate certain of the "blind spots," Pierson and Pack [62] carried out gastroscopic procedures on patients in the sitting posture. The improvement in vision was so striking that this method of examination has been adopted routinely for the study of cancer in the upper third of the stomach.

Preparation of the patient is practically identical with that practiced in gastroscopic examination with the patient in the left lateral position. The patient is seated in a comfortable straight chair, a small pillow being placed in the hollow of the back in order to arch it forward. The gastroscopist stands on two stools, one on each side of the patient's knees or on the left side of the patient. No assistant is necessary, and the procedure is easily accomplished with no more difficulty than that of passing an ordinary stomach tube. They found that more of the fundus becomes visible in this position than with the ordinary technic. They believe that the use of this position in gastroscopic examination will yield more precise information and hope that it will disclose more early resectable lesions.

Hufford [63] reports his observations concerning the use of demerol hydrochloride (1-methyl-4-phenyl piperidine 4-carbonic acid) in the preparation of patients for gastroscopic examination. A group of 32 patients presenting gastric disturbances in which gastroscopic examination was indicated were studied. The best method proved to be intramuscular administration of a single dose ranging from 75 to 150 mg. While no definite conclusions are warranted on the basis of this study, he believes that the drug possesses certain properties which render gastroscopic examination more efficient and less disturbing to the patient than with the usual forms of medication.

62. Pierson, J. C., and Pack, G. P.: Indications for Vertical Gastroscopy, Rev. Gastroenterol. **11**:111 (March-April) 1944.

63. Hufford, A. R.: Gastroscopic Preparation with Demerol Hydrochloride, Rev. Gastroenterol. **11**:328 (Sept.-Oct.) 1944.

Abstracts from Current Literature

Ear

HYDROPS OF LABYRINTH (MÉNIÈRE'S DISEASE) DIAGNOSIS—RESULTS OF LABYRINTH SURGERY. KENNETH M. DAY, Laryngoscope **56**:33 (Feb.) 1946.

Ménière's syndrome or, better, hydrops of the labyrinth is characterized by sudden paroxysmal attacks of vertigo, tinnitus and deafness. The deafness affects various tones and is of the perceptive type. It is usually pitched between 100 and 300 double vibrations per second, although there is often also a high-pitched note. The labyrinth shows a decrease of reactivity proportional to the deafness present. The unaffected side shows a similar but less definite change.

Hydrops of the labyrinth is a disease of middle or later life and occurs about equally in males and females. There are spontaneous remissions. It is almost always unilateral. The cause is unknown in most cases; in some the condition is of an allergic nature. Conservative treatment consists of injections of histamine and, in some cases, nicotinic acid. With those who do not respond, surgical intervention must be thought of. Day feels that operating on the labyrinth itself rather than on the eighth nerve gives the best results. An opening is made in the horizontal semicircular canal, a needle is passed through the opening into the vestibule, and a light coagulating current is applied. In 19 consecutive cases the results have been successful in that the vertigo and the low-pitched tinnitus have disappeared. The patients were able to resume their normal routines. There is still the high-pitched tinnitus, as well as complete loss of hearing. However, in most cases the hearing of the affected ear was of no practical use preoperatively. By varying the method of coagulation, Day hopes to be able to preserve some hearing.

HITSCHLER, Philadelphia.

CEREBELLAR ABSCESS. GEORGE OTTE, Rev. de otorrinolaring. **5**:192 (Dec.) 1945.

Otte presents 8 cases of cerebellar abscess in which the history and the progress presented many interesting problems: First, cerebellar abscess is a frequent association of thrombophlebitis, but it may occur in the absence of an involvement of the lateral sinus, as a complication of labyrinthitis, as a cholesteatomatous growth extending through Troutmann's triangle and as a result of osteomyelitis of the temporal bone. Otte believes that the labyrinthine route is the most common route of infection. In consequence, he stresses the importance of watchfulness in cases of chronic suppurative otitis media which may be complicated by either thrombophlebitis or labyrinthitis. Repeated neurologic examinations are indicated, as are studies of the eyegrounds, lumbar punctures, hemograms and observations of any possible changes of the psychic or mental state of the patient. A diagnosis of frank cerebellar abscess following chronic suppurative otitis media is more or less readily established, but should the abscess follow or be associated with any other complication, such as labyrinthitis, thrombophlebitis or meningitis, it is often difficult to make a clearcut diagnosis. The significant diagnostic signs may be divided into four groups: First, those due to intracranial hypertension, such as intensive occipital headaches, bradycardia, papilledema and vomiting; second, those of cerebral suppuration, such as somnolence, lack of interest, meningitic signs and rapid loss of weight; third, those of cerebellar involvement, such as dysmetria, adiadokokinesis, difficulty in walking and loss of muscular equilibrium; to these must be added, fourth, the evidence of sepsis, such as high temperature and chills, but these are usually associated with the general state of debility, which differs from that seen in thrombophlebitis, in which the patient appears extremely well.

Otte believes that surgical intervention should be done through the mastoidal route for the following reasons: 1. This is the shortest route. 2. It is unnecessary to cause artificial adhesions, by electrocoagulation, between the meninges and the cerebellar surface, since these adhesions have already been formed by the pre-existing inflammatory process. 3. The otitic cerebellar abscess is usually nearer the surface of the cerebellum, at the level of the region of the mastoid process, and hence it is more favorable to the establishment of adequate drainage. Should there be associated meningitis, the conjoined use of penicillin and sulfadiazine should be instituted.

PERSKY, Philadelphia.

LABYRINTHITIS. GEORGE OTTE, Rev. de otorrinolaring. **5**:216 (Dec.) 1945.

Otte in discussing labyrinthitis reviews the common routes of infection, the symptom complex and the classification (Kopetzky). He feels that a differential diagnosis of the various forms is of extreme academic interest and should be made early but that from the therapeutic standpoint it is purely incidental in the present era, when physicians have both penicillin and sulfonamide drugs. He presents a case in which the differential diagnosis between the circumscribed and the diffuse suppurative labyrinthitis was not established preoperatively, but at operation an erosion of the semicircular canal with granulation tissue was found. This was unhesitatingly removed, without any secondary complications. Another case is cited in which symptoms of perilabyrinthitis were presented. Here the entire labyrinth was exenterated, without secondary involvement. Otte, also, minimizes the value of lumbar punctures, and he feels that surgical intervention in most cases of labyrinthitis is definitely limited, since many patients with suppurative otitis media which was complicated by diffuse labyrinthitis and even purulent meningitis have been cured with penicillin without surgical intervention. In closing he states that surgical intervention in diseases of the labyrinth, which at one time constituted the only means of saving the patients, has lost its importance as a result of the interest in new therapeutic measures.

PERSKY, Philadelphia.

CEREBRAL ABSCESS OF OTITIC ORIGIN. RAUL VELASCO LETELIER, Rev. de otorrinolaring. **5**:236 (Dec.) 1945.

In a survey of 9 cases of cerebral abscess, the author found that in every case the abscess was secondary to chronic suppurative otitis media. The organisms isolated were streptococci, staphylococci and pneumococci. The route of infection in 8 of the cases was by continuity; in the ninth it was by the vascular route. There has not been any association, in any of these cases, with thrombosis of a lateral sinus. The symptom complex was varied and often presented problems in diagnosis. The symptoms can be subdivided in relation to the various stages of formation of the abscess. In its incipiency there is localized encephalitis, which may last for a week or more. Here the symptoms and signs are primarily those associated with either a meningeal or a cerebral infection, such as headaches, high fever, rapid pulse, chills, increase in spinal fluid cell count and the presence of leukocytes in the spinal fluid. The headaches are the most persistent finding. The second stage is that of encapsulation of the abscess, which usually takes about three or four weeks. Here the symptoms are quite different, and the author found that vomiting is extremely common but that it is not of the explosive type as is usually assumed; it is generally preceded by marked nausea. The headaches are of the typical hemicranial type. Mental phenomena are common, such as somnolence, intellectual dulness and marked indifference and inattention to surroundings. These mental disturbances were noted in 55 per cent of his cases. Bradycardia is common but a very late symptom. Papilledema is not especially common, but the author stresses the importance of the examination of the eye-grounds. Once the abscess is fairly well encapsulated the temperature is not of diagnostic significance, for it usually assumes the lower level and is more or less constant throughout. If the temperature is high or assumes bizarre characteristics,

one should suspect other complications, such as meningitis or thrombosis of a lateral sinus. However, the author stresses the postoperative importance of the temperature, for if there is an unexpected rise at that time, one should suspect either interference with the drainage of the abscess or the possibility of further extension of the pathologic process. In addition there are other signs of cerebral localization, such as monoplegia, facial paralysis, diplegia and rarely hemiplegia. The nerve reflexes are usually active or even exaggerated. Nystagmus and conjugate deviation of the eyes were seen in only 2 patients.

Lumbar puncture was done routinely on all patients, but the number of cells in the spinal fluid was not of great prognostic significance. The differential diagnosis of thrombophlebitis and cerebral abscess is sometimes difficult.

Velasco Letelier believes that surgical intervention should be done through the mastoidectomy route. If a fistulous tract is found on exposure of the dura, he follows this to the abscess cavity. When it is absent, he does multiple punctures in various directions until he reaches the mass. He emphasizes the importance of securing ample drainage of the abscess, but this must be done only when the abscess is fairly well encapsulated. The sulfonamide drugs and penicillin are of value only postoperatively. Finally, he believes that the neurosurgeon can be of value in those cases in which the fibrotic character of the capsule interferes with normal function of the brain and produces some secondary symptoms, such as epilepsy, vertigo, and migraine.

PERSKY, Philadelphia.

Larynx

LARYNGEAL STRIDOR WITH TEMPORARY CARDIAC AND RESPIRATORY ARREST. ROBERT D. MERCER, Am. J. Dis. Child. **70**:336 (Nov.-Dec.) 1945.

Mercer reports the complications of a surgical success for the correction of congenital atresia of the esophagus with tracheoesophageal fistula. In one interesting postoperative syndrome there was laryngeal stridor of great severity accompanied by temporary cardiac and respiratory arrest. The patient was admitted to the hospital on the fourth day of life at a weight of 5 pounds (2,268 Gm.). There was a history of choking with each feeding. Roentgen studies with a contrast medium revealed atresia of the esophagus combined with presence of air in the stomach. The combination proved the existence of a fistula.

The surgical correction was performed through a parascapular incision on the right side with removal of the posterior portions of the third, fourth and fifth ribs. When the esophagus was exposed, the two segments were found adherent. Only a small portion of each was in contact. The level of contact was about 1.5 cm. above the carina. A telescopic type of anastomosis was performed and the tracheal fistula was closed airtight.

During the first two postoperative days there were periods of apnea and dyspnea. On the twelfth postoperative day the patient began to have severe episodes of stridorous respiration during or immediately after feeding. These became so severe that breathing stopped, and there was no discernible pulse. There was no evidence of cardiac activity. After two minutes the infant vomited, passed a stool and began breathing. The patient was treated with gradually increasing doses of atropine, and the symptoms and attacks gradually decreased until they disappeared altogether.

When the attacks started, it was presumed that there was a leak at the site of the former fistula. Investigation proved this theory wrong. Because no anatomic explanation could be found, the author assumed that the syndrome was a result of excessive vagal stimulation. He doubts that the atropine had much to do with the cure, which he ascribes to the normal development of the infant. He concludes that the syndrome is probably a result of excessive vagal activity initiated reflexly through sensory endings in the pharynx.

ROBERT LEWY, Chicago.

SULFANILAMIDE SPRAY FOR PAIN IN TUBERCULOUS LARYNGITIS. MERVIN C. MYERSON, J. A. M. A. **130**:1014 (April 13) 1946.

In 60 patients with tuberculous laryngitis ulcer formation was treated with a sulfanilamide powder spray (5 to 10 grains [0.32 to 0.65 Gm.]) twice daily. Those having ulcerations not associated with perichondritis of the arytenoids were promptly relieved of pain.

The modus operandi was the clearing up of the pyogenic infection secondary to the tuberculous ulceration. The sulfanilamide does not cake as sulfathiazole does; it is cheaper and more stable than penicillin and less liable to contamination.

With the removal of the painful swallowing the patients were able to eat and gain weight within a few weeks.

An impressive case in point is given. A woman aged 28 with painful tuberculous ulceration of the larynx was using an 8 per cent cocaine spray. With the substitution of sulfanilamide powder spray the cocaine was eliminated at once and the woman was able to swallow in comfort.

Spraying with sulfanilamide powder is not a cure but will prolong life and save a tremendous amount of agonizing pain and inability to swallow.

LIEBERMAN, Philadelphia.

Nose

LOCAL TREATMENT OF MAXILLARY SINUSITIS WITH ALFASOL. HELMER RASMUSSEN, Acta oto-laryng. **33**:419, 1945.

Alfasol (the sodium salt of *p*-[α-ethylsulfonic acid]-aminobenzenesulfonamidothiazole) used in the local treatment of maxillary sinusitis was found to have no effect on chronic and hardly any on acute conditions.

Pneumococci and hemolytic streptococci were the bacterial species of most frequent occurrence. The duration of maxillary sinusitis was independent of the bacterial species. The antral secretion became free from bacteria considerably earlier in the locally treated group than in the control group, in spite of the questionable effect of the treatment on the lesions.

KETTEL, Hilleröd, Denmark.

HETEROTOPIC TUMORS WITH AN INTESTINAL MUCOUS MEMBRANE STRUCTURE IN THE NASAL CAVITY. OSMO JÄRVI, Acta oto-laryng. **33**:471, 1945.

Järvi reports 6 cases of nasal tumor, in all of which epithelium typical of the intestine, smooth muscular tissue corresponding to the muscularis mucosae and a tunica propria layer, as in the intestine, were found. The epithelium was formed of border, goblet, Paneth's and argentaffin cells or of only the two first-mentioned kinds of cells. Structurally 4 of the tumors were adenopapillomas, and 2 of these degenerated into carcinomas, while 2 tumors were found at the first examination to be carcinomas. One of the carcinomas was a typical adenocarcinoma; the other was carcinoma villosum. Two tumors were mucinoid cancers.

The heterotopic nasal tumors in question represented 4.7 per cent of all the epithelial nasal tumors and 16.6 per cent of the papillomas. The tumors most probably arise on the basis of congenital maldevelopments, but an external irritation certainly plays an important part, especially in their carcinomatous degeneration.

KETTEL, Hilleröd, Denmark.

Miscellaneous

REFLEX VASODILATATION IN TUBED PEDICLE SKIN GRAFTS. G. STUART and R. F. WARREN, Ann. Surg. **123**:436 (March) 1946.

Stuart and Warren studied the reflex dilatation which occurs in a tubed pedicle skin graft when a limb is immersed in hot water, in 14 patients. An appreciable

rise in temperature took place in the graft in all but 2 patients. It was observed that vasodilatation was not dependent on an intact nerve supply, although there is a greater response with it. It is emphasized that the tubed pedicles showed marked sensitivity to withdrawal of heat, and that this fact should be borne in mind in cases in which the circulation in a tubed pedicle is faulty.

SELTZER, Philadelphia.

ARTIFICIAL RESPIRATION. J. H. COMROE and R. D. DRIPPS, J. A. M. A. **130**:381 (Feb. 16) 1946.

Comroe and Dripps comment on the paucity of quantitative data on which to make valid comparisons of various technics for performing artificial respiration. The two methods discussed in moderate detail in this article are the Schafer prone pressure and the Eve tilting or gravity technic, the former recommended by the Red Cross and the latter used extensively by the British navy. In the present study observations were made on 2 subjects.

It was found that the Schafer method was inadequate. A larger exchange was observed per cycle in using the Eve tilting or gravity technic. The Schafer method depends to a large extent on the elastic recoil of the lungs and on the tonicity of the respiratory muscles, and since these are absent in the deeply asphyxiated patient, Schafer's method becomes of least value when most needed. On the other hand, Eve's tilting method is efficient when tonus and elasticity of these structures are absent.

In using artificial respiration, the first and most important element is time. Since it takes time to set up the necessary equipment and arrange for skilful help, the Schafer prone pressure method is the method of choice. The second important consideration is to use the most efficient method available to replace the emergency measure. At the earliest possible moment the patient's care should pass from the hands of the fireman or the policemen to those of a physician highly trained in resuscitation; in most hospitals this is the anesthesiologist. Resuscitation of the near-dead is a complex matter involving specialized knowledge of many aspects of respiration and circulation and of the physiology of the central nervous system.

In 1909 Meltzer and Auer noted that life could be maintained for hours in apneic animals without any external respiratory movements if a stream of oxygen was directed through a catheter toward the bifurcation of the trachea. This finding has been confirmed frequently. It has been pointed out that oxygen insufflation does not effectively eliminate carbon dioxide from the lungs; to accomplish this, actual expansion and collapse of the lungs are required. Carbon dioxide has a greater molecular weight than oxygen, and does not diffuse more rapidly in air than oxygen, despite the greater ease with which it diffuses through water and through living membranes.

The enormous increase in the carbon dioxide tension and the acidity of the arterial blood are factors not so readily appreciated by the clinician as a decrease in arterial oxygen tension. High concentrations of carbon dioxide act as a narcotic depressing the medullary centers and the cerebral cortex and lead to a decrease in respiration and to vasodilatation and fall in blood pressure.

These studies emphasize that artificial respiration to be maximally effective must not only raise blood oxygen to normal levels but must reduce blood carbon dioxide to normal levels. The original oxygen insufflation provides adequate oxygen but permits narcotic concentrations of carbon dioxide.

It should be borne in mind that vital capacity is often reduced by accumulation of pulmonary edematous fluid and by atelectasis, the latter brought about by oxygen in the alveoli, apnea and inability to cough up secretions, so that plugging of bronchioles takes place and finally atelectasis.

These studies again emphasize the complexities of treating a near-dead patient and the need for further and more careful evaluation of available technics.

GORDON, Philadelphia.

THEY TOO NEED SPEECH. CHARLES VAN RIPER, J. Except. Child. **12**:134, 1946.

Van Riper pleads that all handicapped children—the blind, the mentally retarded, the deaf and those with cerebral palsy—have training in the art of communication, because emotional adjustment is often obtained by verbalization. "Every handicapped person can be taught to use speech as a tool to adjust not only himself but everyone else to his difference."

PALMER, Wichita, Kan.

THE ACTIVATION OF SKIN GRAFTS. P. ROUS, J. Exper. Med. **83**:383, 1946.

Intrigued with the method practiced in India in early times, reported by Thiersch, of beating the area from which graft material was to be taken with a wooden shoe until well "swollen," Rous experimented with rabbits. The skin was made hyperplastic by the application of irritants. These were chiefly chloroform and turpentine. Examination of sections of the specimens showed that the hyperplastic skin united with the underlying tissue better than normal skin of the same individual and that the blood supply was established more promptly and in greater abundance. The cells of the activated skin proliferate almost immediately to cover adjacent denuded surfaces with a thick layer. There is no interval before beginning proliferation, such as ordinarily occurs. There is less tendency to contract than in normal skin. The donor area was observed to heal more rapidly than usual. Infection was also less frequent. Together with these results, the author emphasizes that there are serious limitations to the method, stating that it may not be practical and that success depends on the preservation of blood supply. One observation may have special significance: that the activated epidermal cells may have such potentiality of growth that they invade the underlying muscle tissue much after the manner of the cells in new growths. This should be given consideration in attempting to use the method on human material.

SELTZER, Philadelphia.

SPEECH REHABILITATION. KATHERINE F. THORN, J. Rehabilitation **12**:31 (March) 1946.

This is a general review of the types of disorders found in the speech corrective field: There is need for an expanded program of speech correction so that therapy will be available to all who require it. The establishment of recognized clinics such as those which are certified by the American Speech Correction Association would reduce materially the number of unsuspecting people who frequent "quack" institutions.

PALMER, Wichita, Kan.

THE USE OF THROMBIN IN RHINOLOGIC SURGERY. A PRELIMINARY REPORT. SAMUEL L. FOX, Laryngoscope **56**:48 (Feb.) 1946.

Thrombin is effective in stopping capillary bleeding and, as a "glue," in promoting rapid adhesion of normal edges of tissue. These uses are of great value in intranasal and rhinoplastic operations.

Twenty-nine cases of rhinologic surgical work are presented, some in detail, in which a thrombin solution was used to cause hemostasis. The results were successful.

HITSCHLER, Philadelphia.

TREATMENT OF MIGRAINE AND RELATED HEADACHES. MAX A. GOLDZIEHER, New York State J. Med. **46**:516 (March 1) 1946.

In a previous article Goldzieher reported 50 cases of severe headache, mostly of the migrainous type. He still holds to the idea that retention of too much sodium chloride and water is commonly found in the patients. Here is a group of 100 consecutive cases to supplement the first series. In the majority a metabolic imbalance was demonstrated as salt retention and water retention. Treatment is based on a high protein diet with restriction of salt, water and carbohydrate intake.

The author administers ammonium and organic potassium salts. Sedation with a mixture of atropine and phenobarbital is also necessary. If there are endocrine deficiencies, these are corrected by proper measures to make up the defect.

VOORHEES, New York.

CONFERENCES ON THERAPY—ORAL PENICILLIN. New York State J. Med. **46**:527 (March 1) 1946.

This report is made up from stenographic notes taken in a "free for all" discussion among members of the department of pharmacology and medicine of Cornell University Medical College and the staff of the hospital, students and visitors. A summary of opinions was drawn up by Dr. Paul A. Bunn. In the first days of the use of penicillin the oral route was tried but was found wanting because the gastric and intestinal secretions rendered it useless for therapeutic purposes. Under reexamination and experimentation the results are now found to be good. One hundred infections caused by pneumococci, gonococci, staphylococci, streptococci and Vincent's organisms were encountered. By mouth, five times the intramuscular dose must be given. The ratio of 5 to 1 is not affected by protecting the drug with beeswax or special capsules or by neutralizing the gastric juice. Test tube evidence of complete and prompt destruction of penicillin gives a false impression. The penetration of the duodenal mucosa is so rapid that penicillin is found in the blood within twenty minutes after ingestion! However, it may irritate the tract. In the lower bowel it is destroyed by the enormous number of germs present. Here absorption is slow, and it is estimated that only about one fifth of the ingested amount reaches the blood. "Sensitive organisms" succumb to penicillin taken by mouth if one gives enough and for not too long a time. There is a "penicillin-fast" possibility. Hence, if the drug is used improperly, for minor complaints, then, when it is needed for a major cause, one may fail to secure good results. This is the best reason that can be given a patient against self medication without medical supervision.

VOORHEES, New York.

DIGEST OF STUDY OF SPEECH CORRECTION IN CITIES OF 100,000 AND OVER. BERNEICE RUTHERFORD, LILLIAN READ and MYFANWY CHAPMAN, Quart. J. Speech **32**:207 (April) 1946.

In forty-three cities of 100,000 or more population a questionnaire was answered completely enough to give some information on the amount of speech corrective service available in these cities. The summary is as follows: 1. The lower the ratio of the school population to the number of speech clinicians the more adequate the service rendered. 2. The itinerant teacher plan and the semiweekly service are typical patterns and not related to adequacy of service. 3. Service is inadequate generally. 4. The typical procedure to determine who needs speech correction services is a combination of clinical survey and observation of classroom or some other referring combination. 5. Speech correction service is given to about 2 per cent of the elementary school population. 6. Speech clinicians in most cities are required to have either specialized training or a degree in speech pathology. 7. The questionnaire itself allowed some variation in interpretation.

PALMER, Wichita, Kan.

THE SPEECH INTELLIGIBILITY PROGRAM IN NAVAL AVIATION: HISTORICAL SUMMARY. M. D. STEER and J. M. HADLEY, Quart. J. Speech **32**:217, 1946.

Voice communication is the method most widely used in naval aviation, and at the same time it is the method most susceptible to imperfection. Failures may occur in various language difficulties, inadequate speech technic, incorrect use of communications equipment, failure of transmission systems, noise interference, poor listening habits, etc. The authors summarize the program of training of personnel, list the research projects completed and, in general, summarize the excellent work done by the Navy in this direction.

PALMER, Wichita, Kan.

News and Comment

Pan-American Congress.—A meeting of the Pan-American Congress of Oto-rhinolaryngology and Bronchoesophagology will be held in Chicago in October 1946, sponsored by the American Academy of Ophthalmology and Otolaryngology, with the cooperation of the societies of otorhinolaryngology of the other American republics and Canada. This meeting will follow immediately after, and overlap, the annual meeting of the American Academy of Ophthalmology and Otolaryngology. Those attending the Pan-American Congress from other countries will be invited to participate as guests in the scientific and social activities of the meeting of the Academy. All otorhinolaryngologists of good standing in North, Central and South America and the West Indies are invited to attend.

The Pan-American Airways and connecting railways, as well as railroad and steamship lines, will be requested to allow discounts on fares for those attending the Congress.

Every effort will be made to secure hotel accommodations in Chicago, provided reservations are made long enough in advance.

The registration fee for the Pan-American Congress will be $5.

Those wishing to attend the Congress are requested to communicate immediately with the Secretary. Titles for papers or motion picture films in any of the four official languages, Spanish, Portuguese, French and English, are solicited by the Program Committee.

Chevalier L. Jackson, Secretary.
Pan-American Congress of Oto-Rhino-Laryngology
and Broncho-Esophagology
255 South 17th Street
Philadelphia 3, Pa., U. S. A.

Directory of Otolaryngologic Societies *

INTERNATIONAL

First Pan-American Congress of Oto-Rhino-Laryngology and Bronchoesophagology

President: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Chevalier L. Jackson, 255 S. 17th St., Philadelphia 3.
Place: Palmer House, Chicago. Time: Oct. 17-19, 1946.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. J. Mackenzie Brown, 1136 W. 6th St., Los Angeles.
Secretary: Dr. Fletcher D. Woodward, 104 E. Market St., Charlottesville, Va.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
President-Elect: Dr. Alan C. Woods, Johns Hopkins Hospital, Baltimore 5.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100–1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 13-18, 1946.

American Broncho-Esophagological Association

President: Dr. Robert M. Lukens, Medical Arts Bldg., Philadelphia 2.
Secretary: Dr. Paul Holinger, 700 N. Michigan Ave., Chicago 11.

American Laryngological Association

President: Dr. Frank R. Spencer, Physicians Bldg., Boulder, Colo.
Secretary: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Harry W. Lyman, 906 Carleton Bldg., St. Louis.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.

SECTIONS:

Eastern.—Chairman: Dr. Robert F. Ridpath, 18th and Chestnut Sts., Philadelphia.
Southern.—Chairman: Dr. Walter T. Hotchkiss, 541 Lincoln Rd., Miami Beach, Fla.
Middle.—Chairman: Dr. Oliver E. Van Alyea, 135 S. La Salle St., Chicago.
Western.—Chairman: Dr. Colby Hall, 1136 W. 6th St., Los Angeles, Calif.

American Otological Society

President: Dr. William E. Grove, 324 E. Wisconsin Ave., Milwaukee, Wis.
Secretary: Dr. Gordon D. Hoople, 713 E. Genesee St., Syracuse, N. Y.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Alfred Schattner, 115 E. 61st St., New York.
Secretary: Dr. Norman N. Smith, 291 Whitney Ave., New Haven, Conn.
Place: New York. Time: Nov. 14, 1946.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.